Energy in Sustainable Urban and Rural Planning

MSESSD

(Core Course II-4 credits)

Course coordinator

Assoc. Prof. Dr. Sushil B. Bajracharya

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1.LECTURES

ENERGY FOR SUSTAINABLE URBAN AND RURAL PLANNING

MSESSD
I Year/I Part
(COURSE II - 4 CREDITS)

Time Schedule: 16 Feb - 18 March 2016



Course Coordinator

Dr. Sushil B. Bajracharya

SYLLABUS

Introduction of Planning

- Urban and Rural Planning
- Sustainable development

Energy resources in Nepal and world

- Traditional, Commercial, Alternative

Energy demand in Urban and Rural settlements

Energy scenario in Nepal

- Energy consumption pattern
- Energy consumption in different Sector
- Energy consumption in Residential sector
- Energy consumption in Transportation sector
- Energy consumption in Commercial sector

International Energy Efficiency and sustainability practices in Urban and Rural Planning

- International practices
- Eco-city concept
- Urban Village concept
- Solar city concept

Energy and sustainability in Urban Planning

- Integrated land use
- Improving town planning
- Integrated transportation
- Improving Infrastructures
- Improving Urban services
- Life style and human behavior for Energy Efficiency
- Application of Eco-city concept

Energy and sustainability in Rural Planning

- Integrated energy system – biogas

Application of Energy and sustainability in Urban and Rural Planning

- Household level
- Community level
- City level
- National level

SYLLABUS

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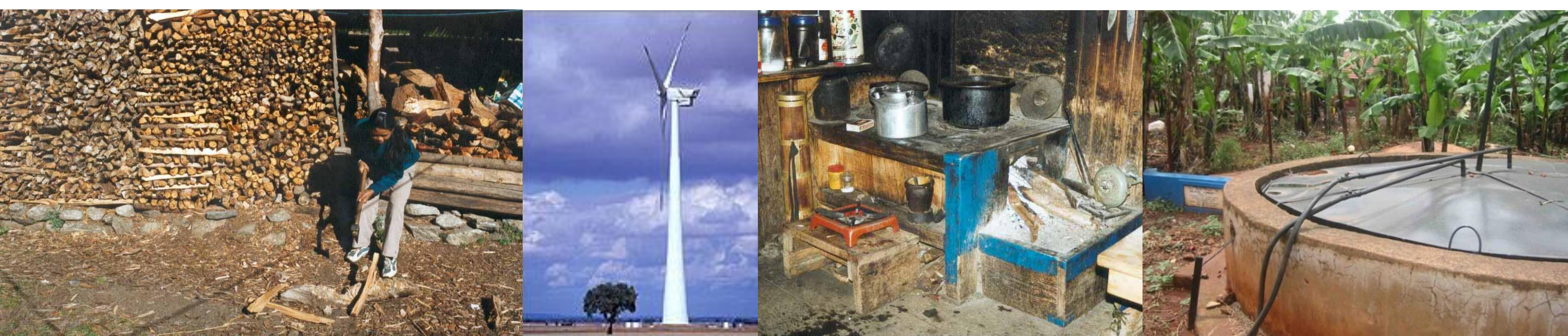
Energy and sustainability in Rural Planning

- Integrated energy system – biogas

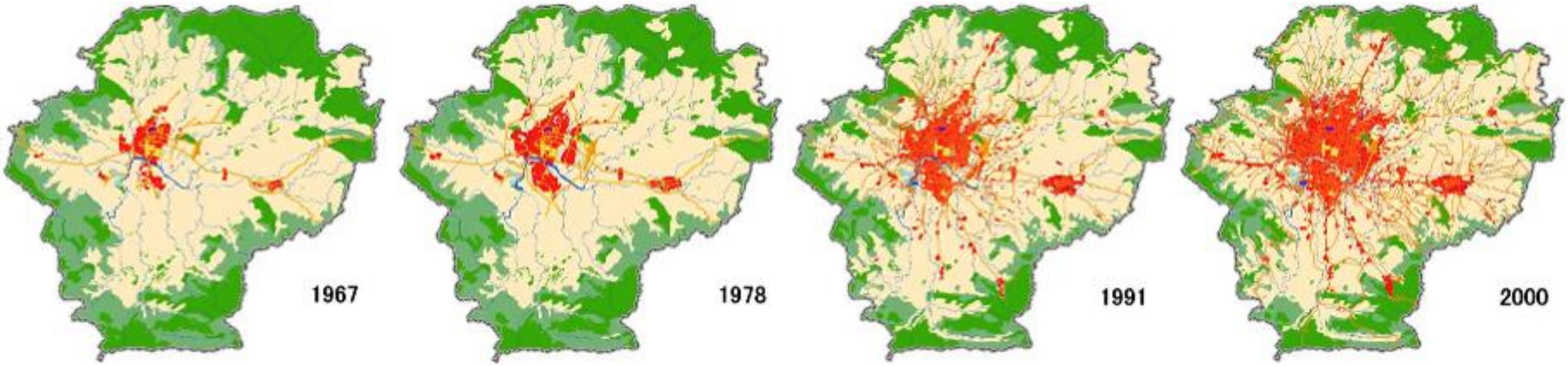


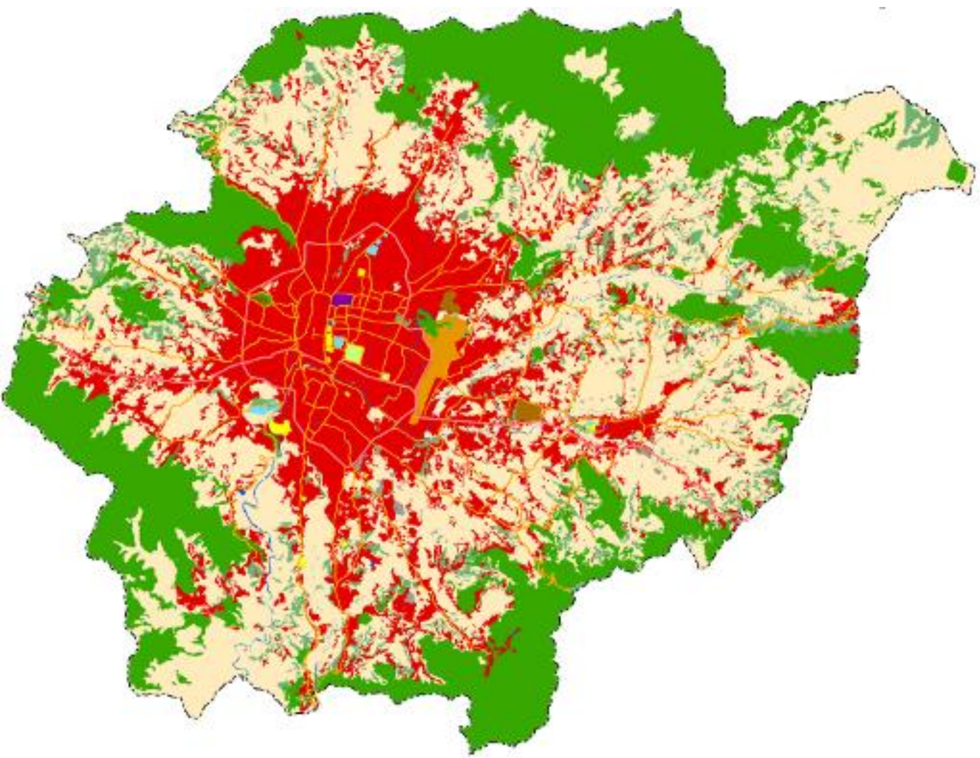
OBJECTIVE TO STUDY OF ENERGY

- To introduce the role of energy and sustainability in planning both urban and rural context;
- Enable application of sustainable energy in designing and planning
- Analyze and plan urban and rural settlements with sustainable and energy efficiency aspect
- To plan Ecofriendly settlements using maximum natural energy for better environment and comfort



ENERGY DEMAND IN URBAN AREA OF NEPAL
- RAPID URBANIZATION





- Rapid urbanization - major issue of the Energy demand of Kathmandu Valley
- (Source: UN Habitat Nepal)

Year	Built-up area		Increase rate
	ha	%	%
1967	2,010	2.9	
1978	3,362	4.9	67
1991	6,313	9.2	88
2000	9,717	14.2	54
2011	16,216	24.7	67

2.SEMINAR

3.ASSESSMENTS

ENERGY DEMAND IN URBAN AREA

- High Urban Growth

4.7 % annual growth & > 60% population growth in KTM

- Need of 1 million urban houses during 2011-2021

- To meet the need for housing,
55 billion bricks i.e. more than 230,000 *tera-joule energy*

Kathmandu - densely populated and unplanned city
(Source: Shrestha S. 014, UN Habitat Nepal)

ENERGY DEMAND FOR HOUSING
– Past to Present

From GREEN towards GREY

(Photo Source: Shrestha S. 014, UN Habitat Nepal)

HOUSING DEVELOPMENT IN RURAL AREA

- Compromising comfort & energy efficiency

Vernacular buildings replacing by modern design, form, materials & technology:

Design & Form:
- Slope roof > Flat roof
- Thick wall > Thin wall
- Load bearing system > RCC frame structure
- Roof projection > without projection

Natural > Artificial materials:
- Slate roof > CGI roof
- Sun burnt brick > burnt brick
- Mud mortar > Cement mortar
- Timber, brick, tile floor > RCC floor

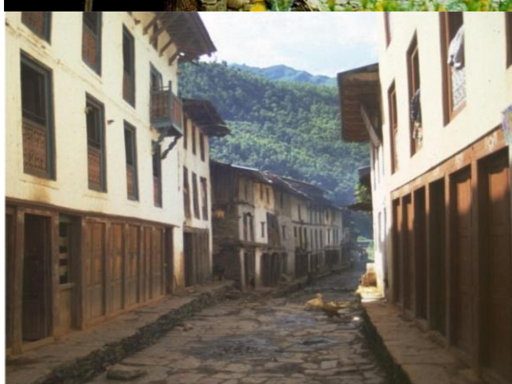
Compromising comfort & energy efficiency:
- Reducing use of solar energy
- Depending artificial energy
- For thermal comfort
- For heating, cooling, lighting, etc.

HOUSING DEVELOPMENT IN NEPAL

TRADITIONAL > CONVENTIONAL > PASSIVE / ENERGY EFFICIENT/ GREEN BUILDING

TRADITIONAL | **CONVENTIONAL** | **PASSIVE / ECOFRIENDLY**

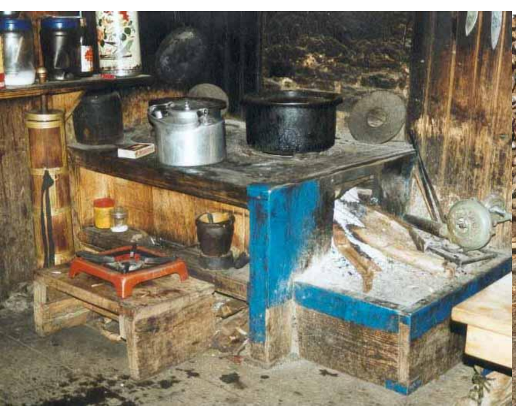
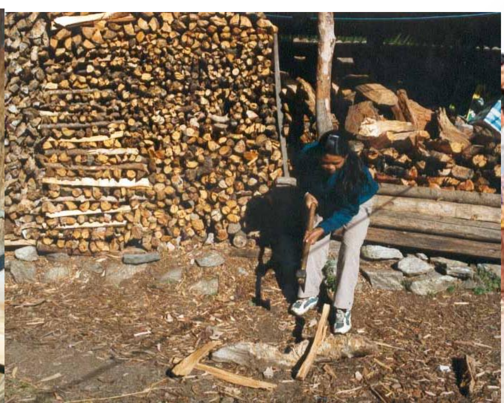





ENERGY SCENARIO

- In the history, people use energy or fuel
- for cooking, boiling, lighting & space heating by burning wood in their homes
- Till today, rural people use it where no power system (electricity)
- Later, people use to survive with commercial energy (gas, kerosene, diesel, etc.)
- People dependent much more to survive with commercial energy (gas, kerosene, etc.)
- As well as fulfill comfort level for heating, cooling, lighting

ENERGY SITUATION

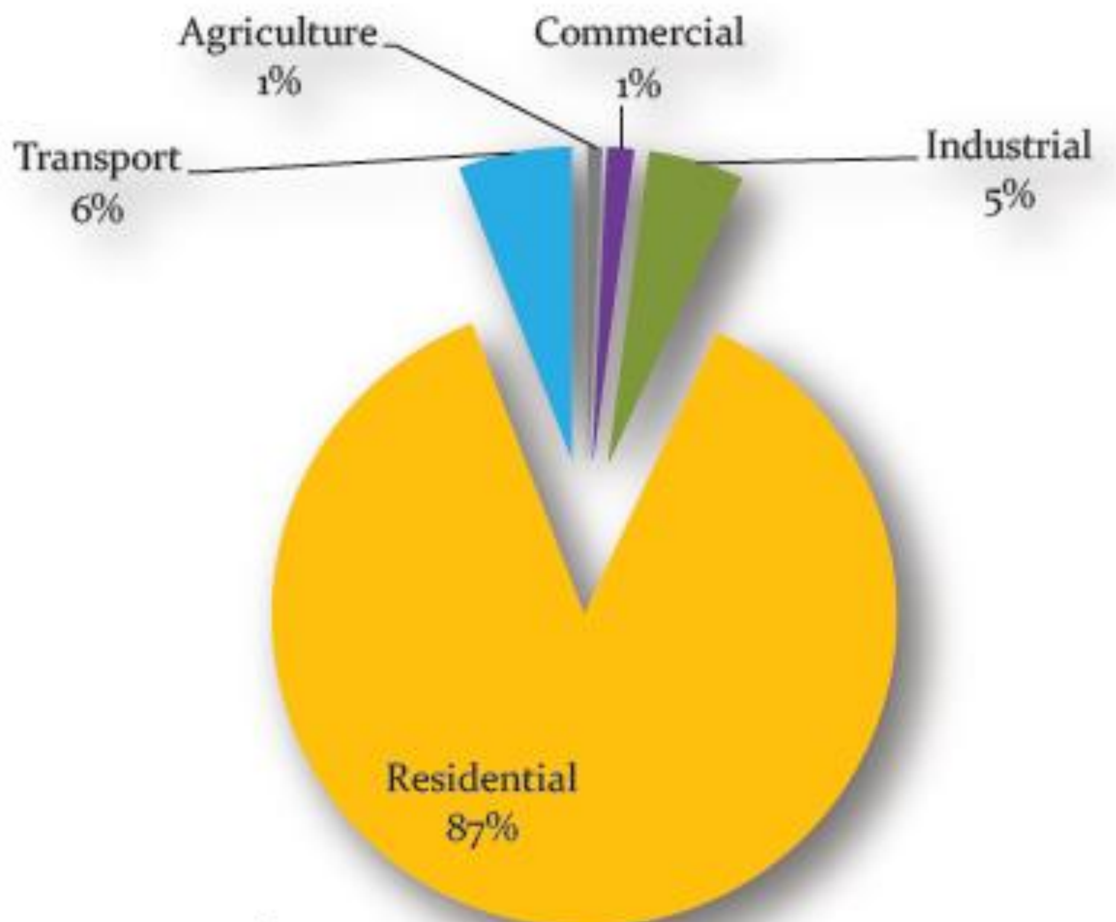
IN THE PAST

- Many energy crisis in the history
- In 1972 “oil embargo” – fuel crisis
- OPEC raised oil price
- USA became oil importer instead of exporter
- some countries became richer & other poorer
- OPEC countries became rich i e Saudi Arabia, Kuwait, Brunei

IN THE PRESENT:

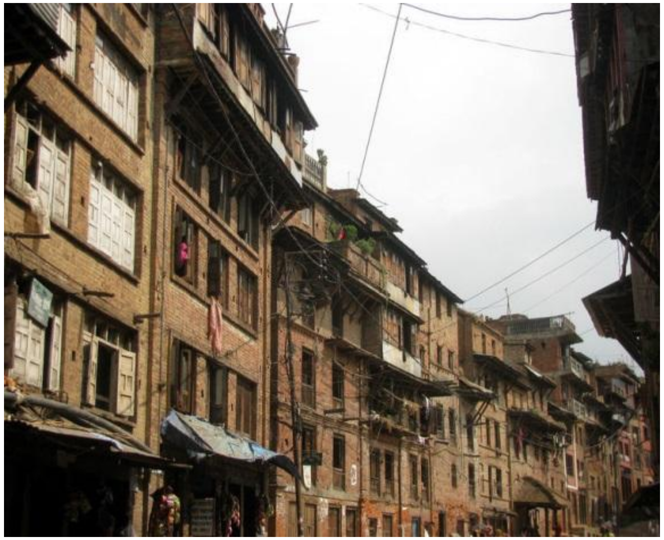
- Load shading in Nepal >12-16 hrs in winter
- Oil & Gas crisis in Nepal
- price raising everyday in the world market & Nepal,
- Need more energy to manufacture brick, cement, bar, etc

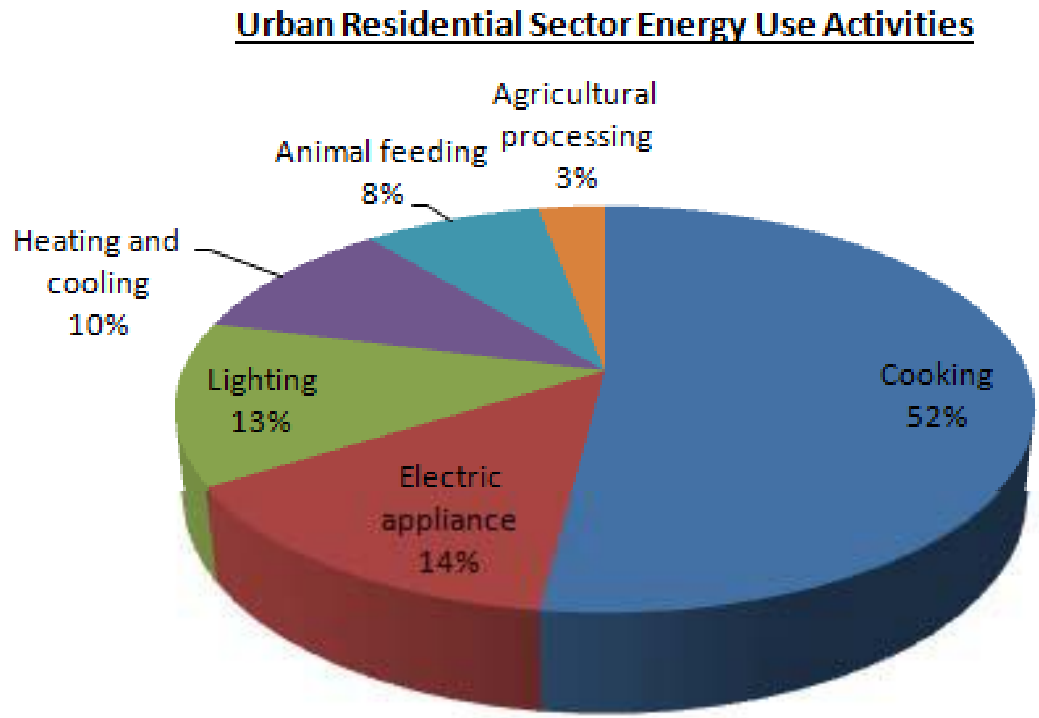
Energy consumption by Economic Sectors



(MOF, 2012; WECS, 2010)

ENERGY USED BY RESIDENTAL SECTOR

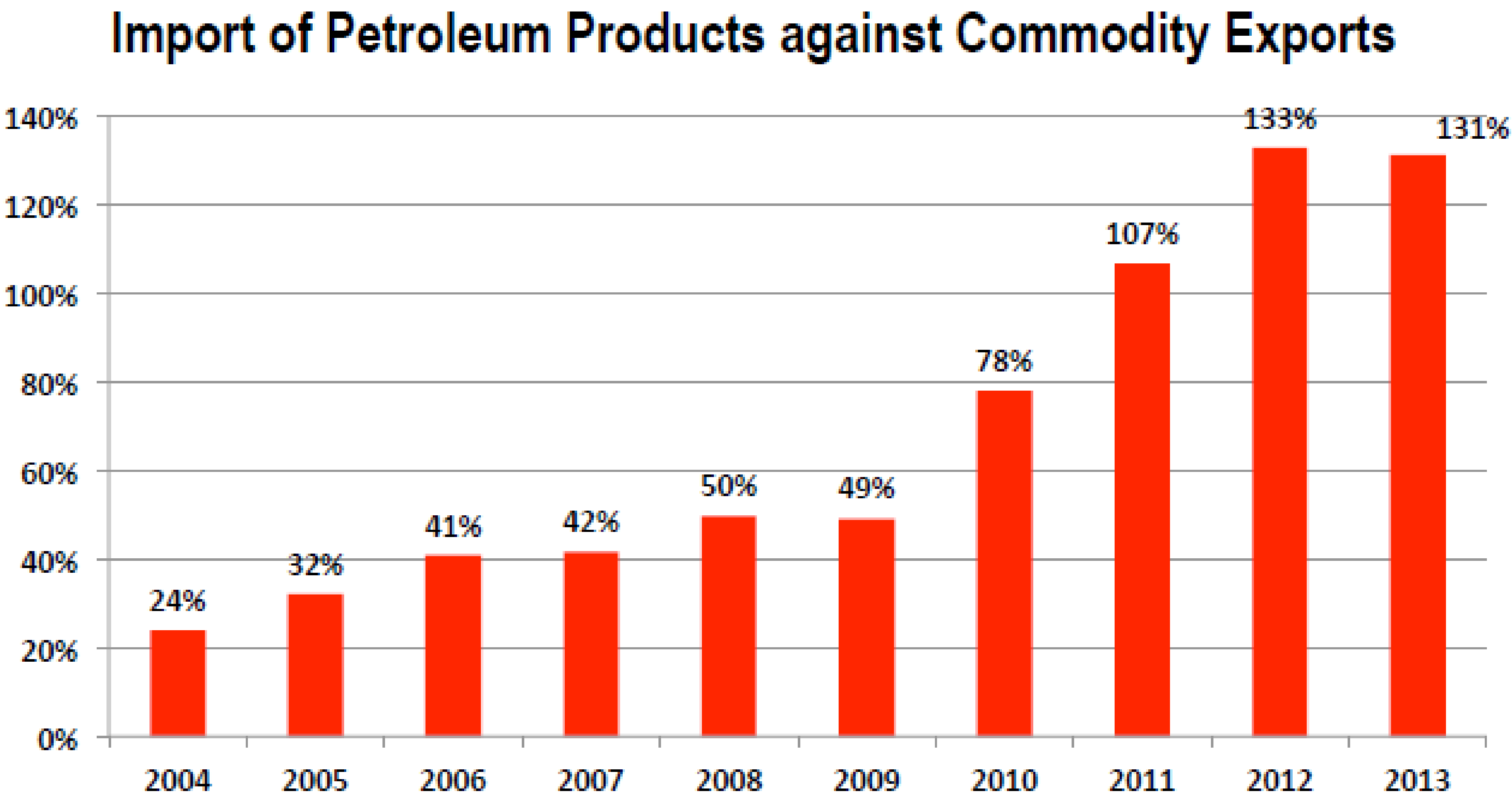




- Figure : Urban residential sector energy use activities

Source: Maharjan S.2013 Energy Efficiency in KMC,M. Sc. thesis, MSUP, IOE

Fossil Fuel



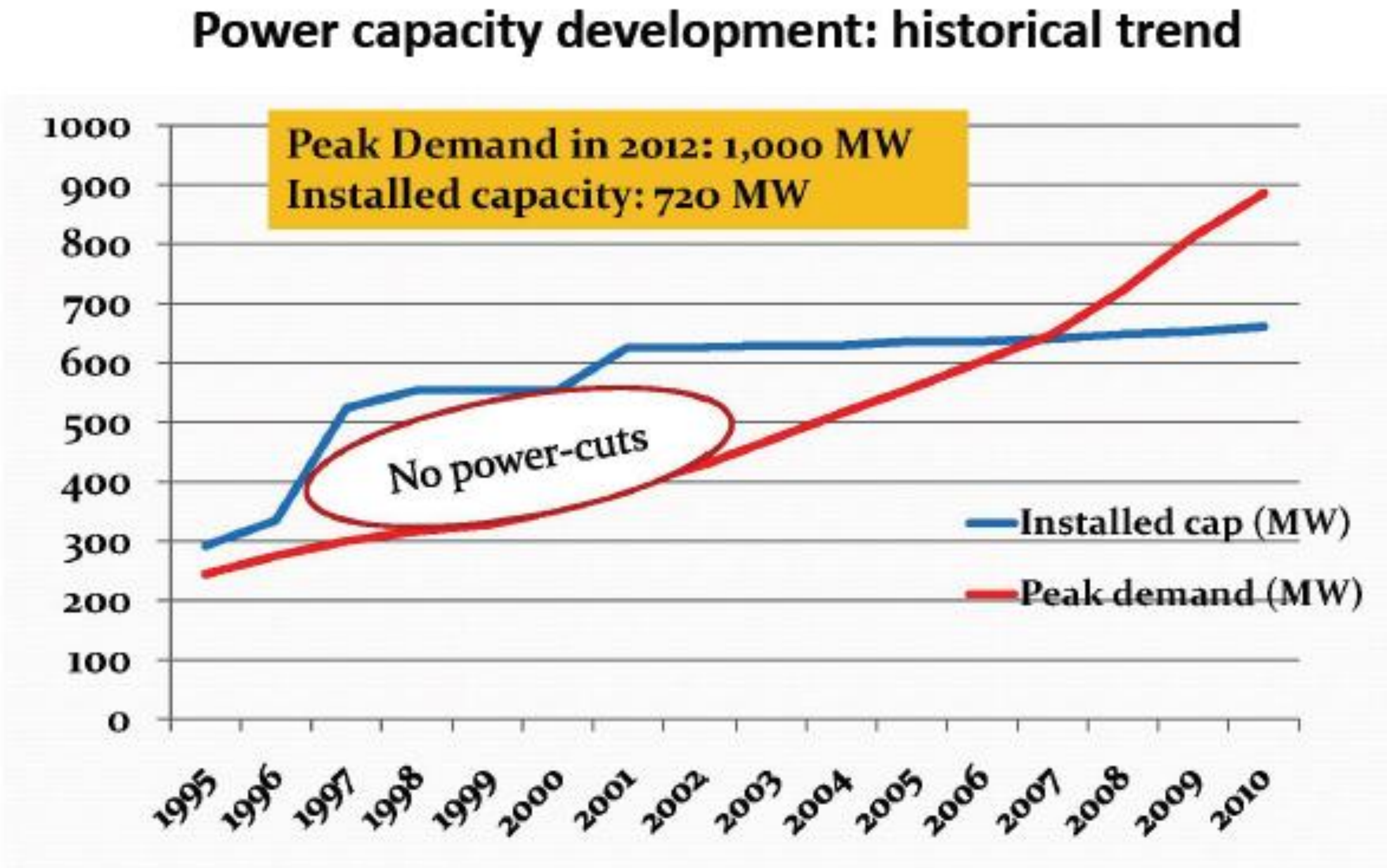
- **Economic Vulnerability increasing**

(Source: MOF, 2013; NOC, 2014)

Slide courtesy Prof. A.M. Nakarmi, CES

ENERGY SCENARIO IN NEPAL

Power Capacity versus peak load

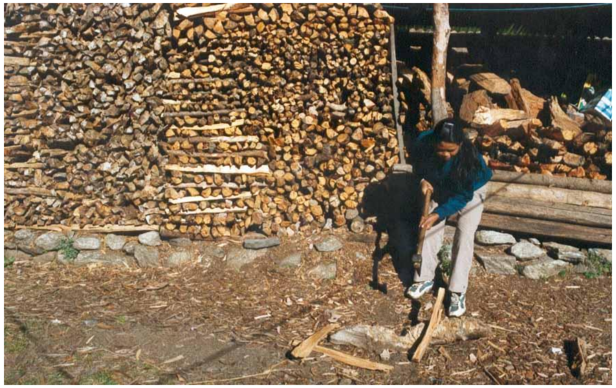


Source: NEA (2012), Slide courtesy Prof. A.M. Nakarmi, CES

ENERGY SCENARIO IN NEPAL (1994/95)

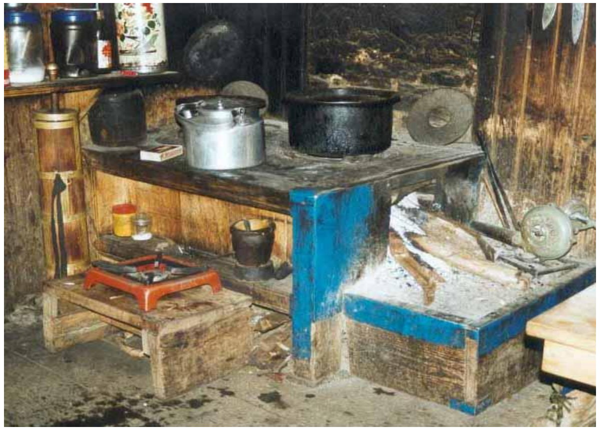
TRADITIONAL ENERGY = 92%

- **Wooden fuel = 69%**
- **Agric residue = 15% (Bhus)**
- **Cow dung = 8% (Gobar)**
- **TOTAL = 92%**



COMMERCIAL ENERGY = 7%

- **Oil (petrol) = 6%**
- **Coal = 1%**

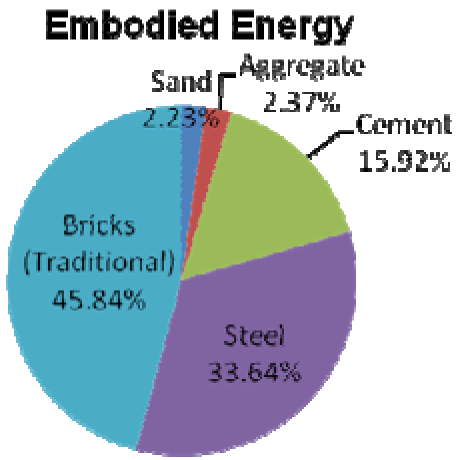


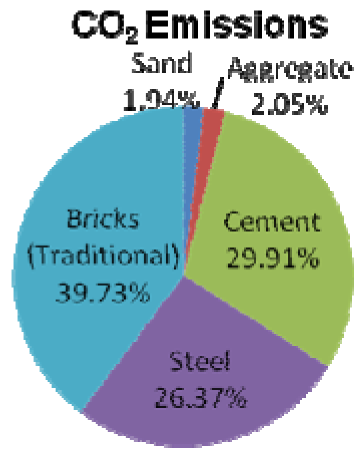
RENEWABLE ENERGY = 1%

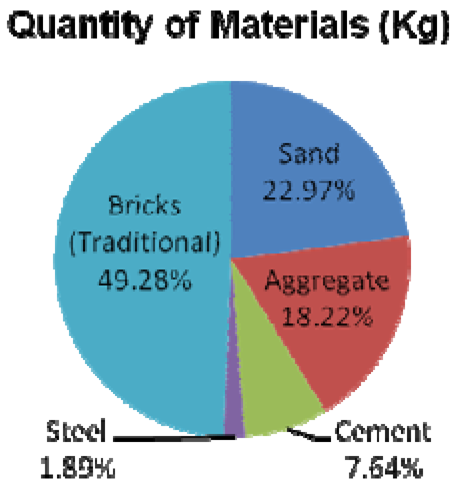
- **Hydro = 1%**
- **TOTAL = 100%**

EMBODIED ENERGY & CO EMMISSION FROM BUILDING

- From Conventional housing sector







<u>TYPICAL LOW RISE BUILDING</u>

(Photo source: Shrestha S. 014, UN Habitat Nepal)

- **To enhance sustainability and resource efficiency,**
- **Need to optimize the use of steel, concrete, glass and water**
- **as well as replacement of fire-brick**

ENERGY SCENARIO IN NEPAL

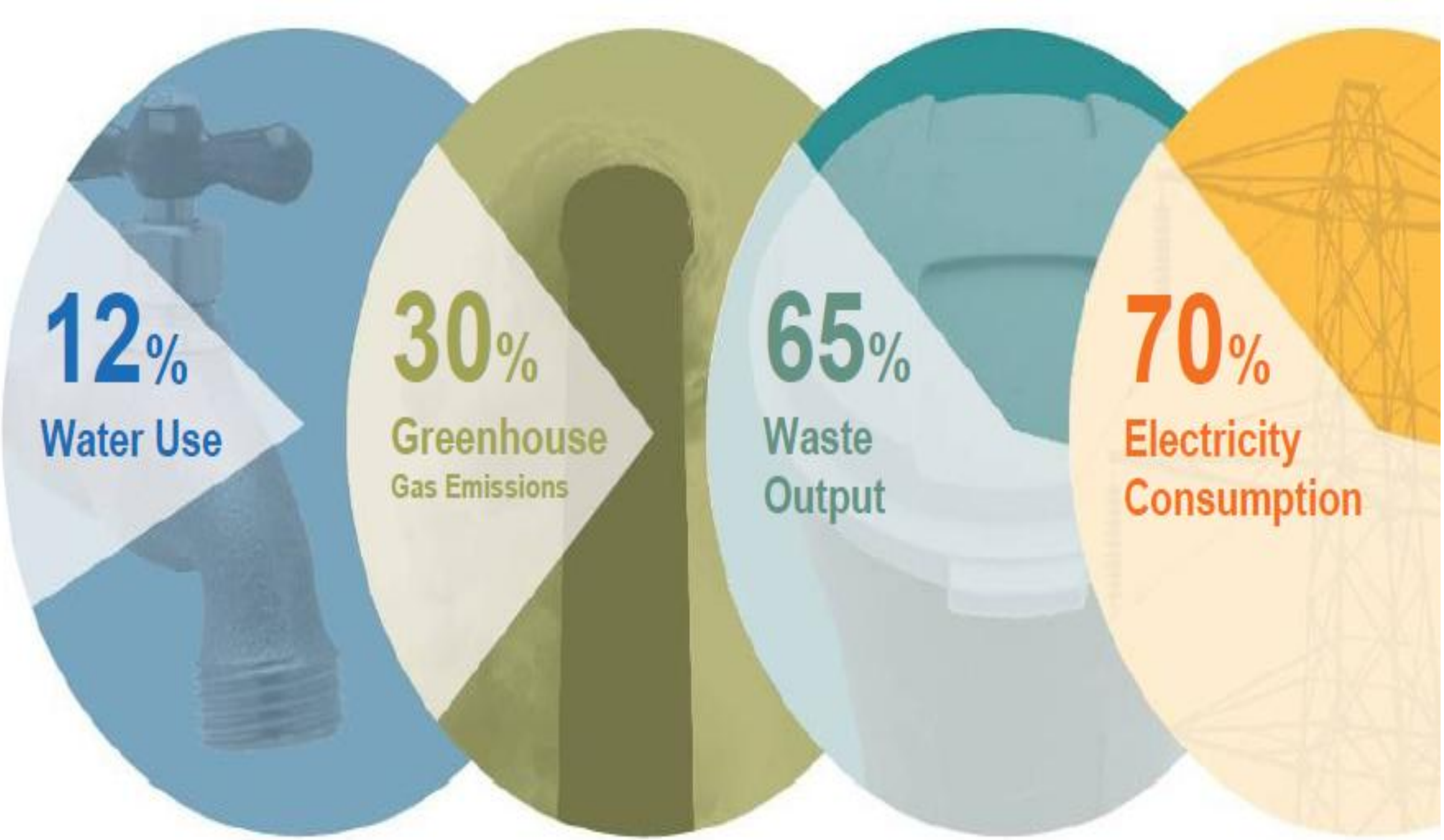
- Max. daily 12-16 hours load shedding per day in winter in Nepal
- Min. daily 6 hours load shedding during monsoon season

- Energy crisis - petrol, gas, electricity, etc.
- Whereas second largest energy generation capacity from hydro power in Nepal after Brazil

- But there is a hope; abundantly find solar, hydro, wind, bio fuel, etc in Nepal for sustainability in future

ENERGY USED SCENARIO IN THE WORLD

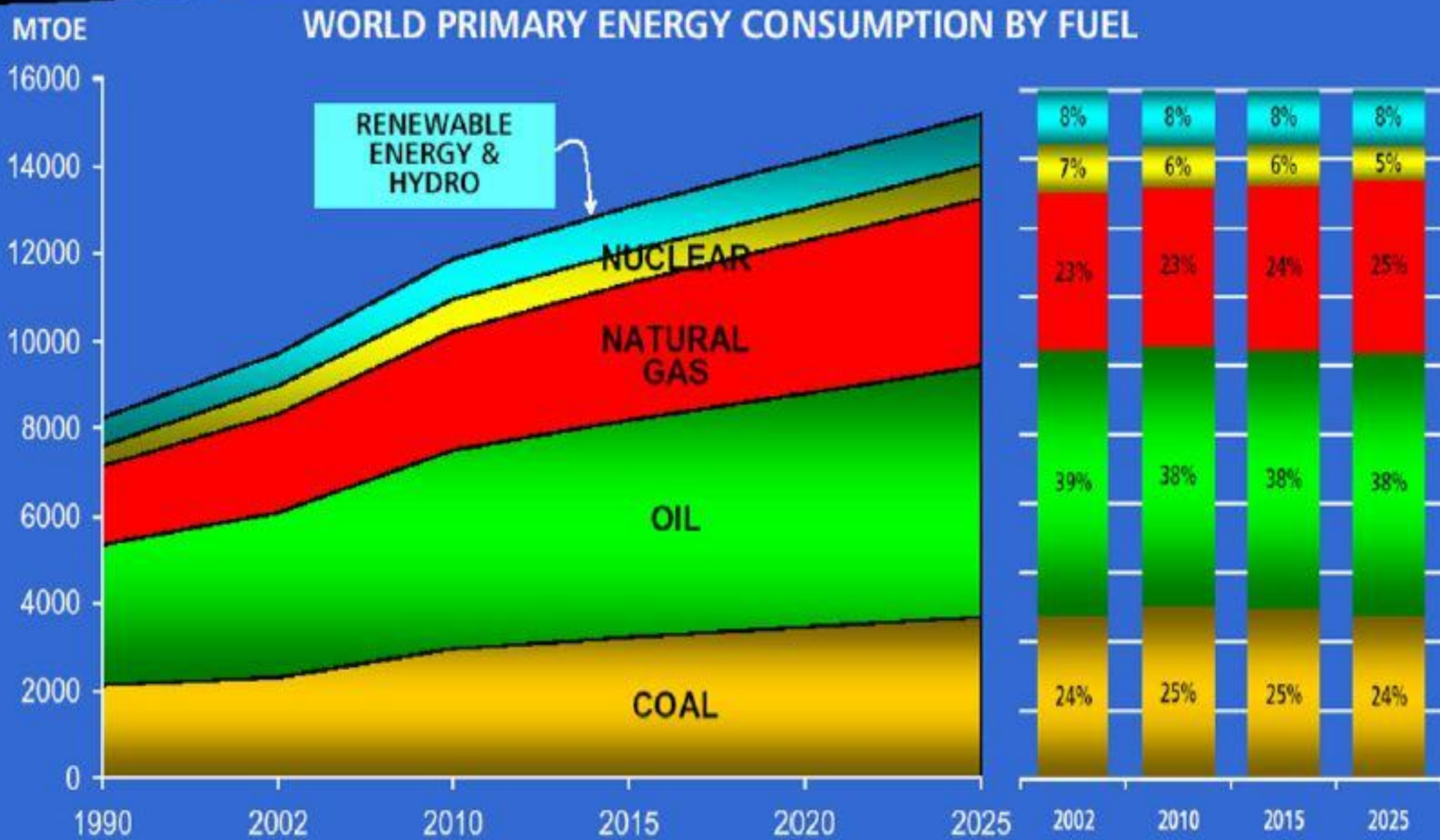
Worldwide Building Accounts for



Perceived Advantage of Building Green (Source: US Green Building Council)

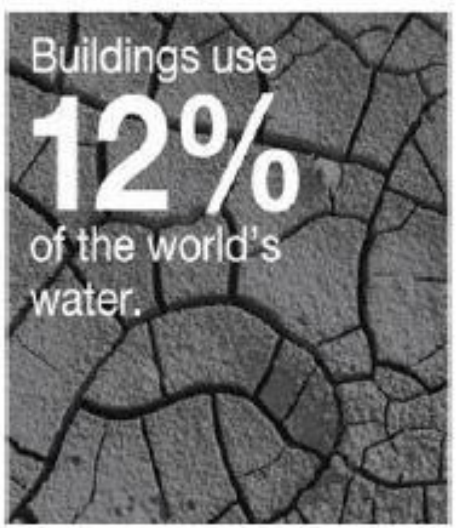
Some 85-90 %t of the world primary energy consumption will continue to be based on fossil fuels

ENERGY CONTEXT

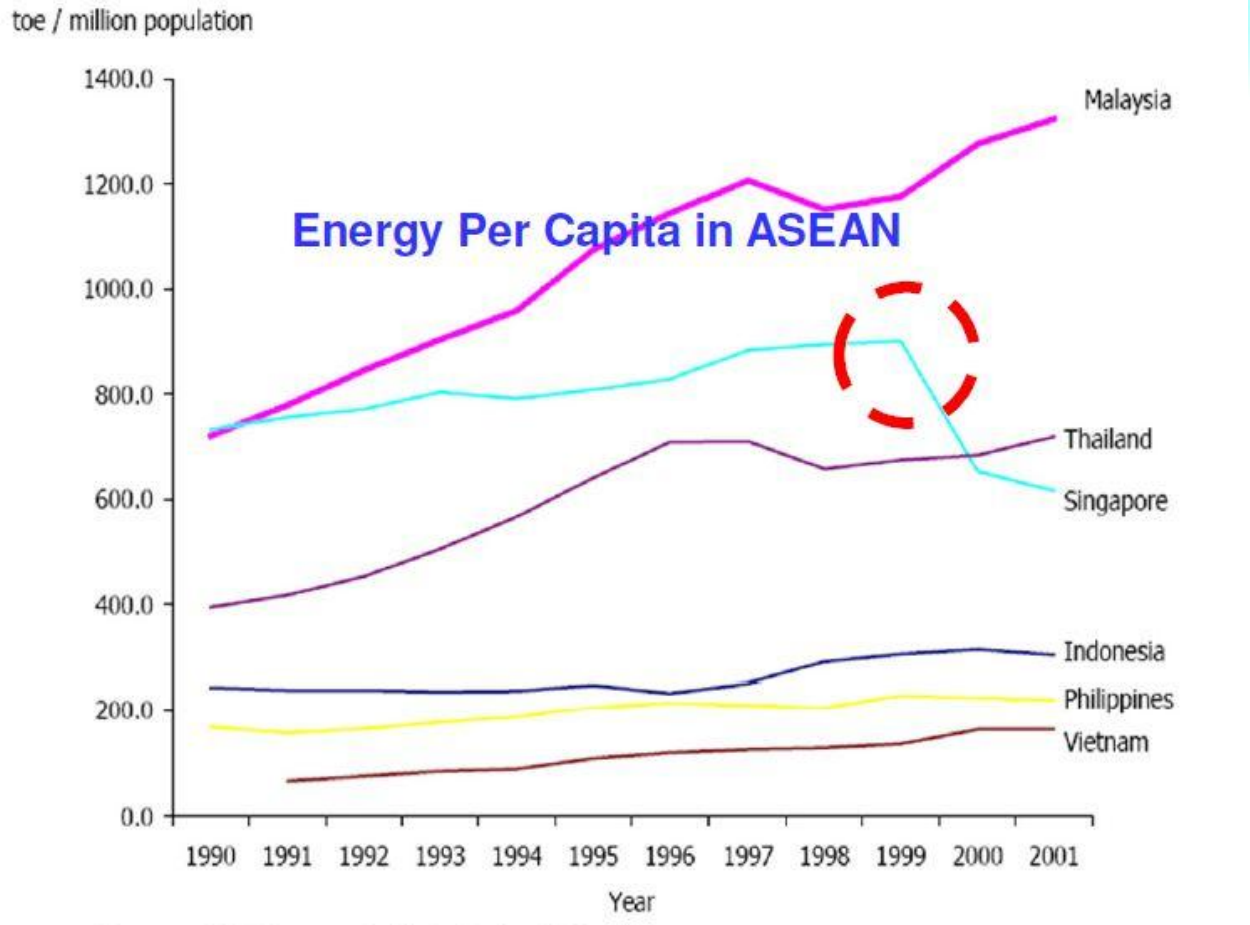


Source of data: International Energy Outlook (IEO) 2005

Impact from Buildings

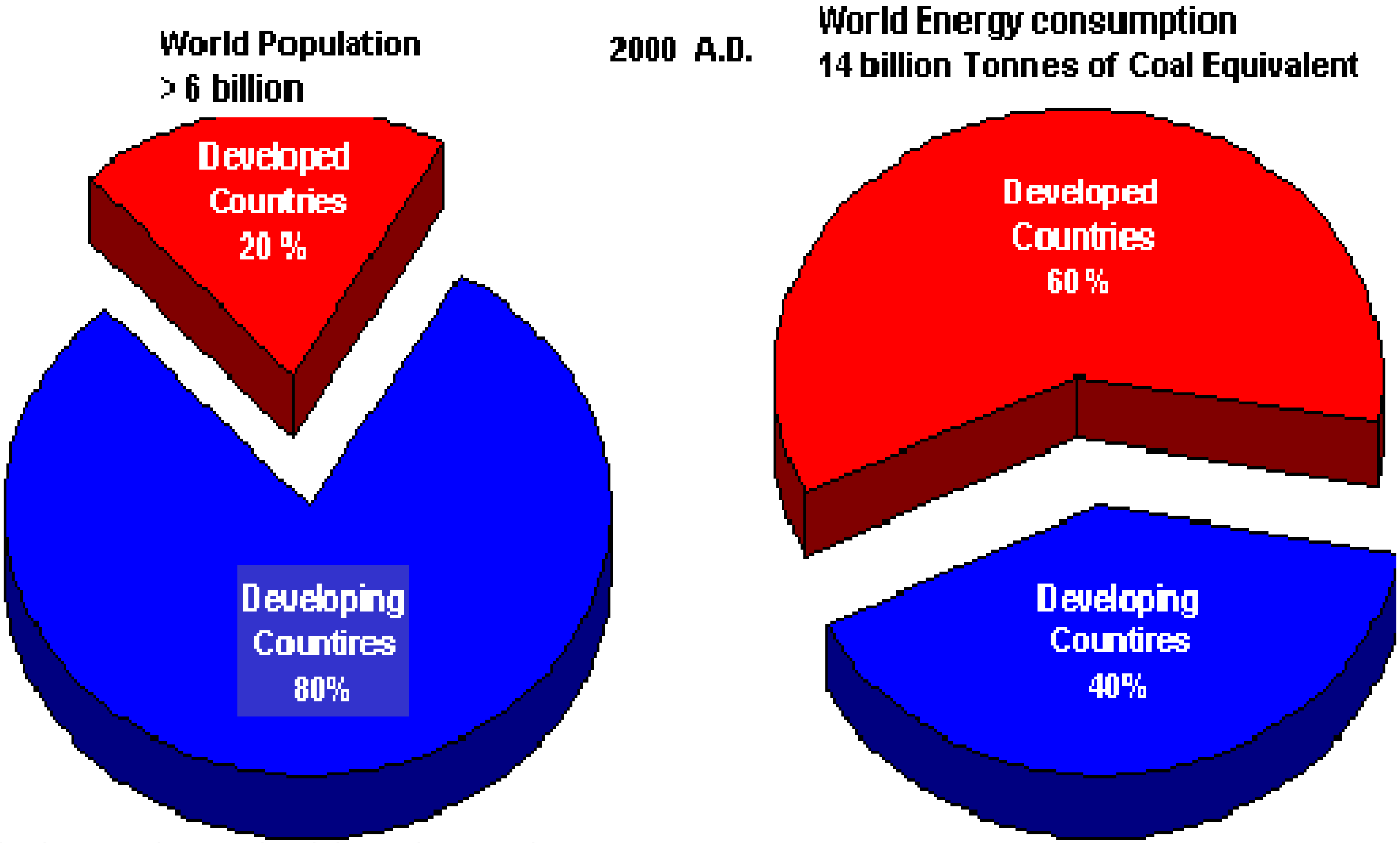


ENERGY PER CAPITA



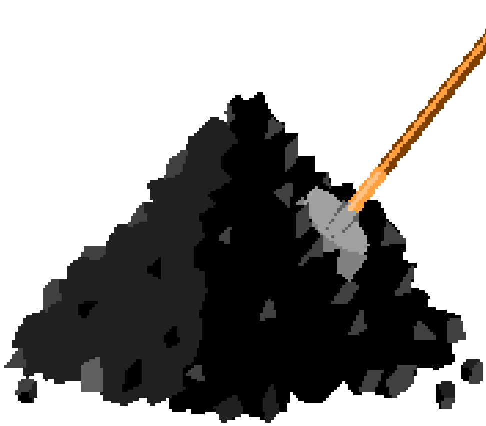
Source: APEC Energy Analysis Tools, 2003 Edition

ENERGY SCENARIO- IN DEVELOPING & DEVELOPED COUNTRIES



Energy distribution between developed and developing countries

ENERGY USED SCENARIO IN THE WORLD



Commercial/ Mineral Energy = 75%

- **Oil = 33%**
- **Coal = 23%**
- **Gas = 19%**

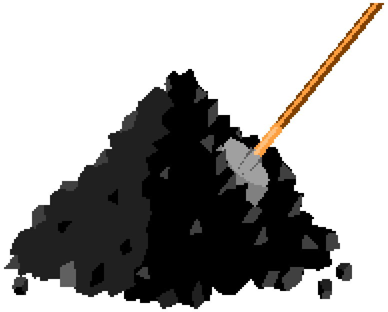
TOTAL = 75 %

Renewable Energy = 25%

- **Hydro = 6%**
- **Atomic = 7%**
- **Biomass = 12%**

TOTAL =25%

ENERGY CRISIS IN FUTURE



- Need more energy than today
- Till 2020, 50% more energy estimated as need in Asia & S America
- Traditional fuel energy running out

- according to 1992 data :
  GAS – 65 years reserve
  COAL – 200 years reserve
  OIL – 100 years reserve

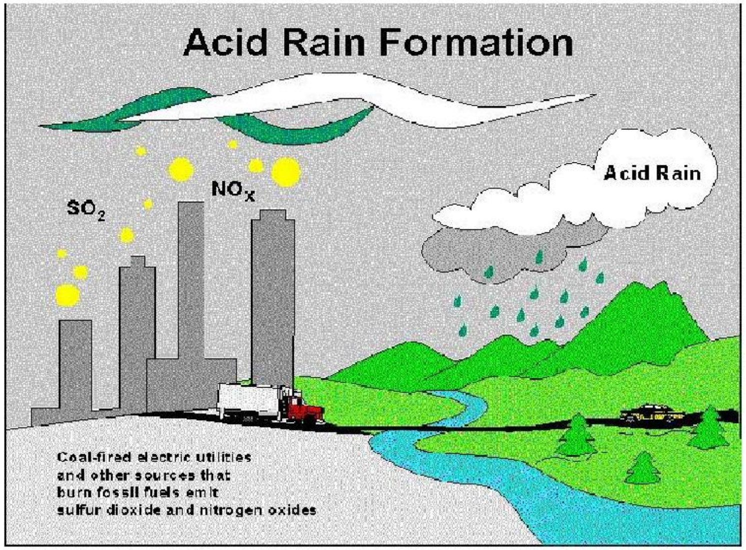
SOLUTION:

- Application of sustainable urban and rural planning
- Eco city
- Solar city
- Cycle city
- Compact city
- Urban village concept

ENERGY SCENARIO IN PAST, PRESENT & FUTURE

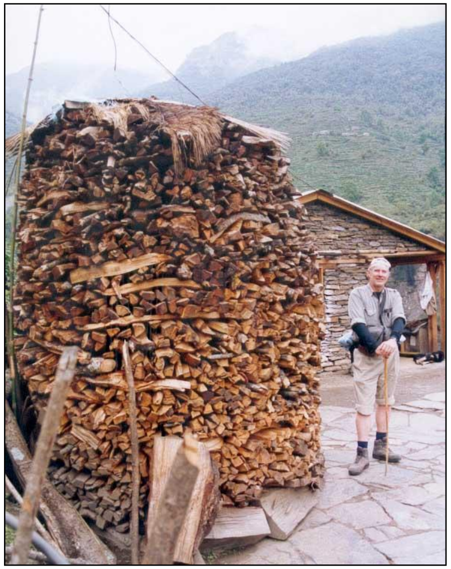
PRESENT:

- Today use of traditional commercial energy related many problems
- ENVIRONMENTAL & SUSTAINABILITY



Environment problem –

- Global warming
- Acid rain,
- Oil pollution in sea,
- Radioactive waste from atomic station (Chernobyl 1986,Japan 2011)
- Unbalance ecosystem & air pollution



Sustainability problem –

- no stock
- running out

ENERGY USED SECTOR

ENERGY

HOUSEHOLD

-cooking, lighting,
heating, cooling,
Boiling

INDUSTRY & AGRICULTURE

Production, construction,
& agriculture
-Electrical energy
-Heat energy,
- lighting,

COMMERCIAL & TRANSPORTATIONAL

-electric, petroleum
-heating, cooling,
-lighting

ENERGY USED IN DIFFERENT SECTOR IN NEPAL IN 2010 (WECS):

- RESIDENTIAL = 87%
- OTHER = 13%

- Industrial = 5%
- Transportation = 6%
- Commercial = 1%
- Agriculture = 1%
- TOTAL =13%

ENERGY AND SUSTAINABILITY IN PLANNING

1. Integrated land use
2. Improving town planning
3. Integrated transportation
4. Improving Infrastructures
5. Improving urban services
6. Improving Life style & human behavior
7. Application of Eco-city

1. Household level
2. Community level
3. City level
4. National level

SOLUTION FOR ENERGY SITUATION

Building Integrated PV Electric System

Center for Energy Studies
IOE/TU

6.5 kWp generating abo
kWh per day

Centre for Energy Studies, Institute of Engineering, Tribhuvan University

1 kW Grid Integrated PV Power at CES

SOLUTION FOR ENERGY SITUATION

Solar PV power Home

Centre for Energy Studies, Institute of Engineering, Tribhuvan University

SOLUTION FOR ENERGY SITUATION

Potential Technologies

Air-conditioning or Refrigeration

Pool Heating

Large scale water heating

Steam by Solar Water Heating

Nepal

Centre for Energy Studies, Institute of Engineering, Tribhuvan University

DESIGN STRATEGIES FOR HOT CLIMATE

FEATURES

Site Planning :
- Water bodies at SW corner,
- Deciduous trees at
- East-West direction

Building Orientation:
- E-W direction

Opening
- Maximum at North with cross ventilation

Material
- Brick wall with 8" cavity

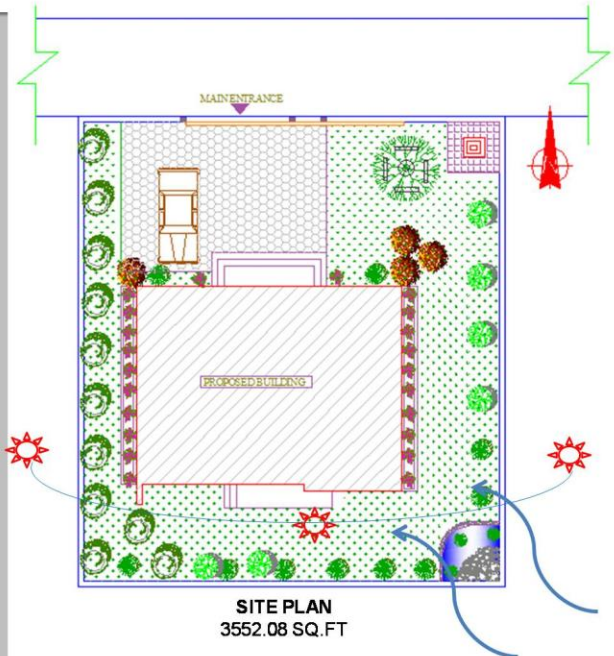
Color and texture
- Light/ Rough

Flooring
- Maximum Marble/Tile

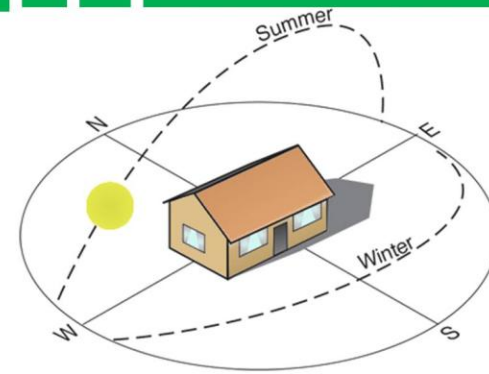
Floor Height - 10'

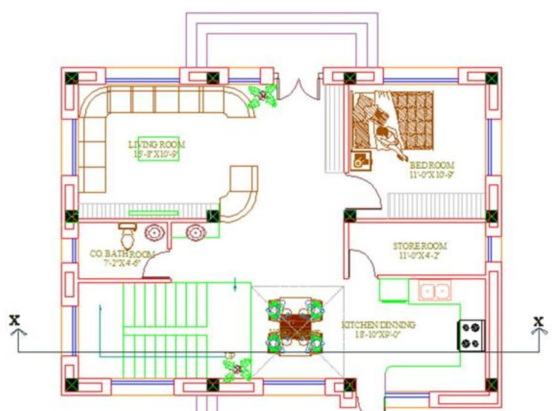
Lintel Height - 8' with ventilation

Terrace garden



SITE PLAN
3552.08 SQ.FT





GROUND FLOOR PLAN
940.5 SQ.FT

Principle of Natural ventilation

ENERGY EFFICIENCY IN BUILDING

Charged an **ELECTRIC CAR** from the solar Energy produced by the **SOLAR PV SYSTEM.**

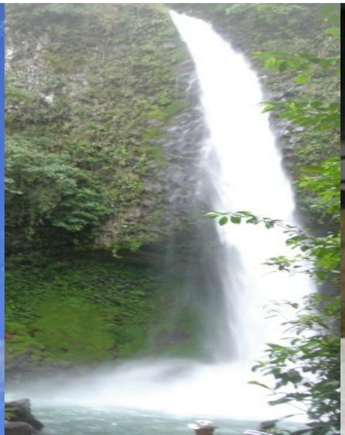
- use a 9-kW solar arrays, charge 24 batteries capable of holding 70 kW-hours of power.
- Excess power then use to powered the electric car.

ZERO ENERGY BUILDING

THANK YOU

Course Coordinator

Dr. Sushil B. Bajracharya

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&

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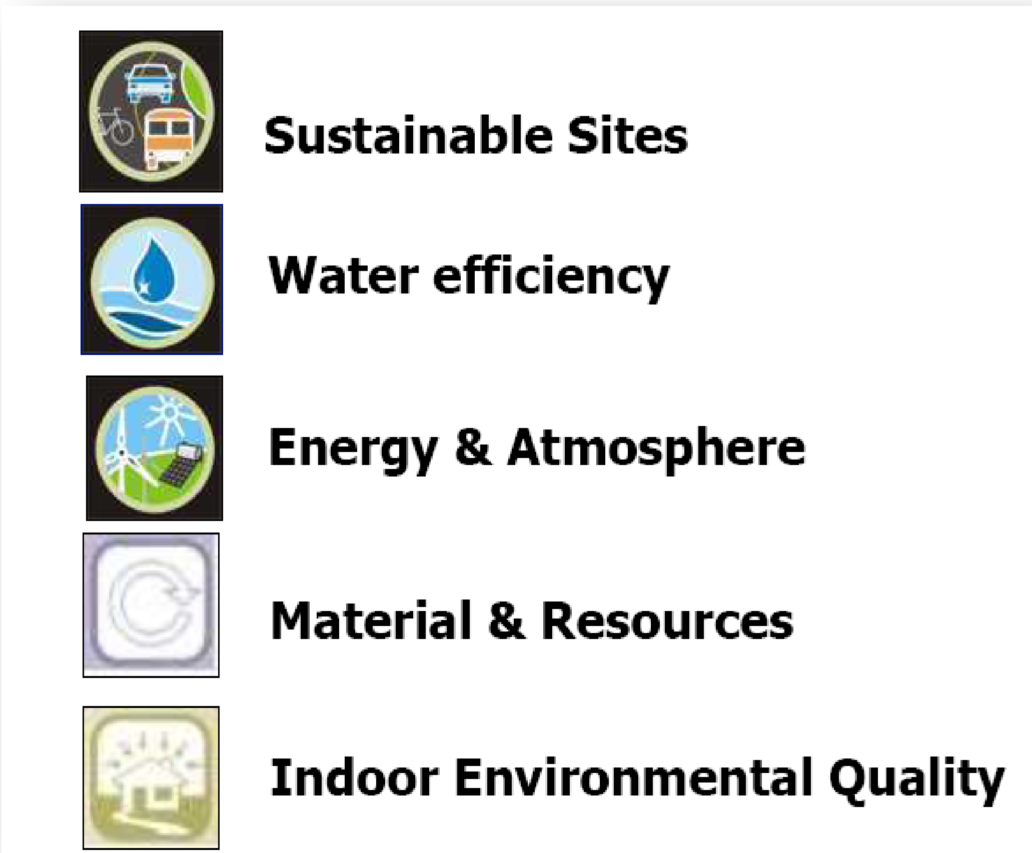
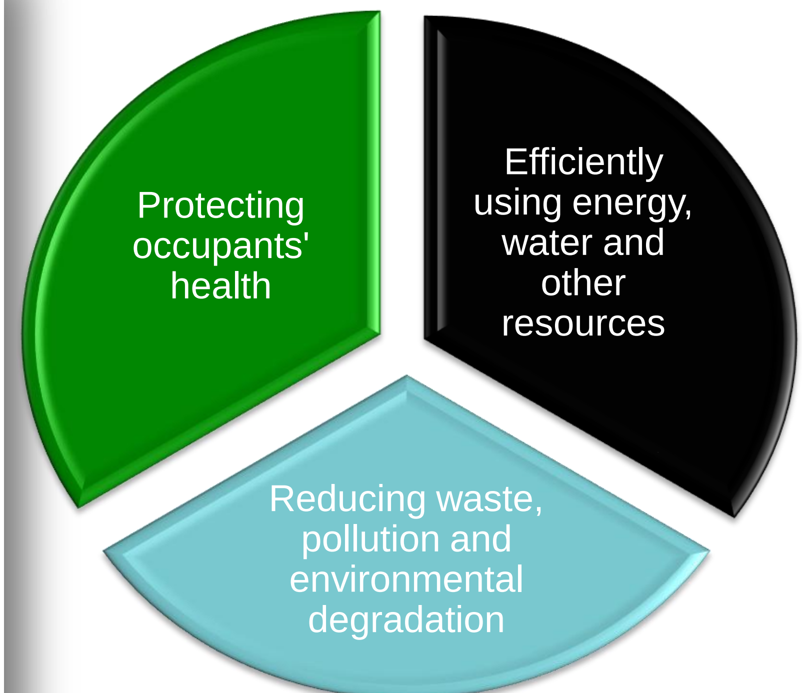
Future Housing – Sustainable & Green Concept

- We are talking about the five eternal elements, the *Panch Tatwa*

    o earth   o water   o fire   o air   o sky

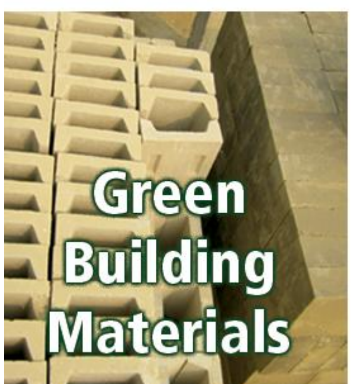


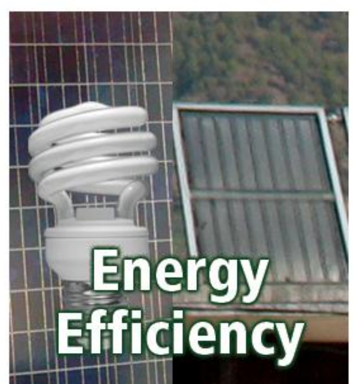


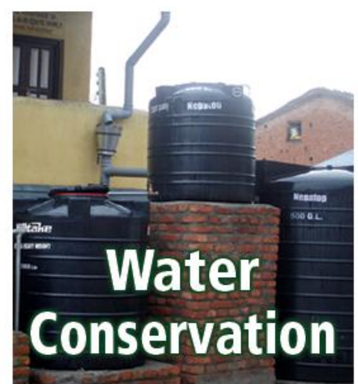
GREEN HOMES

Promotion of sustainable Housing in Nepal

UN Habitat Nepal programme

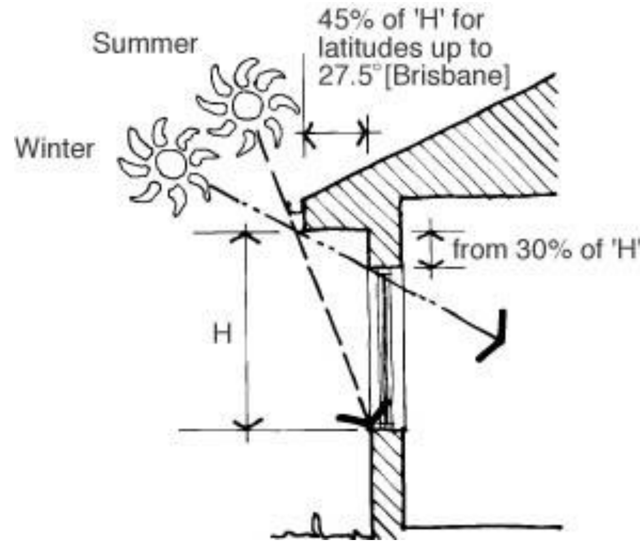


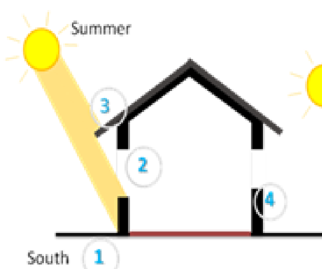


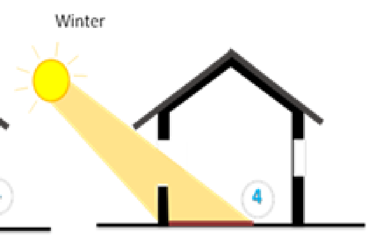


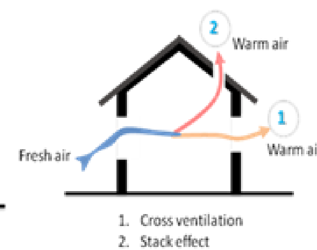
Green Homes: Promoting Sustainable Housing in Nepal

Passive Solar Design



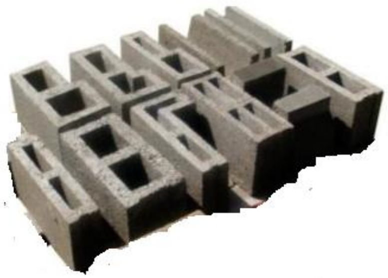






Green Homes: Promoting Sustainable Housing in Nepal

Green Construction Materials



Green Homes: Promoting Sustainable Housing in Nepal

Energy Efficiency

6

Green Homes: Promoting Sustainable Housing in Nepal

Water Conservation

7

Green Homes: Promoting Sustainable Housing in Nepal

Waste Management

8

GREEN MATERIAL, TECNOLOGY
FOR
FUTURE HOUSING




COMPRESSED SOIL BLOCK IN BRICK SIZE

Green Housing in Pokhara

- Green buildings with low cost concrete block in Pokhara

(Source: Field visit_UN Habitat Training Pokhara_Dec 2014)

GREEN HOMES & SUSTAINABLE HOUSING PROGRAM

OF UN HABITAT

– TRAINING FOR ARCHITECT & ENGINEERS OF LALITPUR, DHARAN & POKHARA MUNICIPALITY

- PASSIVE DESIGN FOR DHARAN & POKHARA

Green Homes Bye-laws incorporated in Dharan Municipality

ब) **विशेष प्रकारका भवनहरु** : तारे होटल, सिनेमा घर, सभागृह, मल्टिप्लेक्स, सपिङ्ग कम्प्लेक्स, सुपर मार्केट, साना/घरेलु उद्योग, ठूला उद्योग, मोटर गाडी मर्मत कारखाना, निजी नर्सिङ्ग होम, पोलि क्लिनिक, अस्पताल पेट्रोल पम्प आदि ।

भ) संस्थागत भवन : शैक्षिक, सरकारी, अर्द्ध सरकारी, गैर सरकारी संघसंस्था भवन

म) **हरित भवन /आवास** : निम्न उल्लेखीत एक वा एक भन्दा बढी विषयहरु (Components) समावेश गरिएको भवन ।

- वातावरण मैत्री तथा दिगो भवन निर्माण सामग्रीको प्रयोग।
- घाम सदुपयोगी डिजाईन तथा आन्तरिक वायुको गुणस्तर वृद्धि।
- भवनमा सौर्य उर्जा साथ उर्जा किफायती प्रविधीहरुको प्रयोग।
- भवनमा वर्षातको पानी सङ्कलन प्रणाली, पानी बचत हुने उपकरणको प्रयोग तथा भवनबाट निस्केने फोहोर पानीको उपयुक्त व्यवस्थापन।
- भवनबाट निस्कने फोहरमैलाको विसर्जन वा पुन : प्रयोगको व्यवस्थापन।

२. योजना मापदण्ड

कुनै पनि व्यक्ति/निकायले भवन निर्माण, भवन वा जग्गाको उपभोग/उपभोगको प्रयोजनमा परिवर्तन तथा जग्गाको विकास गर्न चाहेमा सो सम्बन्धि स्वीकृतीको लागि नगरपालिकामा

Green Homes Promotional Policy in Dharan Municipality

१. धरान नगरपालिकाले हरित आवासको कार्यविधि बनाई आगामी ३ वर्ष भित्रमा हरित आवासिय नगरको रुपमा विकास गर्ने ।

२. हरित आवास निमार्ण गर्ने घरधनीहरुको लागि नि : शुल्क प्राविधिक सहयोग उपलब्ध गराउने ।

३. हरित आवास निर्माणका लागि स्थानिय स्रोत साधनको प्रयोगलाई बढी प्राथमिकता दिने ।

४. हरित आवास निर्मातालाई नक्सा पासमा लाग्ने दस्तुरमा छुट दिने ।

५. हरित आवास निर्माणका लागि अनुमति पाएकाहरुको आवासलाई नियमित अनुगमन र नियमन गर्ने ।

६. हरित आवास सम्बन्धि तोकिएको मापदण्ड विपरित बनाईएको भेटिएमा त्यस्ता घरधनीलाई न.पा. बाट उपलब्ध सेवा र सुविधाबाट वन्चित गर्ने ।

७. हरित आवासको मापदण्ड अनुरुप श्रेणीकरण गरिएको घरधनीहरुलाई श्रेणी अनुसार न.पा. को अन्य सेवा सुविधामा समेत सहुलियत दिने ।

८. हरित आवासको लागि अन्तराष्ट्रिय स्तरमा प्रचलित मापदण्डहरुलाई नेपालको कानुनमा समावेश गर्ने ।

९.हरित आवास निर्माणमा सम्लग्न जनशक्तिहरुलाई अनिवार्य रुपमा तालिम लिएको हुनुपर्ने ।

१०. हरित आवास निर्माण गर्ने घरधनीहरुलाई ऋण उपलब्धताका लागि वातावरण तयार गर्ने ।

११. निर्माण भईसकेका भवनको हकमा अवस्थाको अध्ययन गरी हरित आवास अवधारणाको केही बुदा समेत लागु गराउने ।

Green Homes Promotional Incentive Mechanism

- 50% discount in Building Permit Fees

अनुसूचि १७		
घरनक्सा पास दस्तुर अन्य शुल्क दस्तुरहरु		
क्र.सं.	विवरण	दर रु.
१	कम्पाउण्डवाल प्रति रनिङ फिट	४।००
२	लोड वेयरीङ घर प्रतिवर्गफिट (कच्चि सडक)	७।००
३	आर सि सि घर प्रतिवर्गफिट (कच्चि सडक)	१०।००
४	लोड वेयरीङ घर प्रतिवर्गफिट (पक्कि सडक)	५।००
५	आर सि सि घर प्रतिवर्गफिट (पक्कि सडक)	७।००
६	नक्सा संशोधन गर्नु परेको खण्डमा हाल लाग्ने कुल क्षेत्रफलको नक्सापास दस्तुरको १५% थप दस्तुर लाग्नेछ ।	
७	छुटको व्यवस्था	
	क) हरीत आवाश गृह निर्माण गर्नेलाई दस्तुरको ४०% छुट दिईनेछ ।	
	ख) भुकम्पिय सुदृढिकरण गरी भवनको स्तरोन्नती गरेको खण्डमा लाग्ने दस्तुरमा ५०% छुट दिईनेछ ।	
८	२०६४ भाद्र ५ पछि नगरपालिकाको स्वीकीृत विना बनेका घरको दस्तुर प्र.व.फिट	३०।००
९	प्लटिङको नक्सा पास प्रतिकठ्ठा	१०००।००
[illegible]	[illegible]	[illegible]

Further Plan

Incentive Mechanism

क्रियाकलाप	लक्षित समुह	स्रोत	जिम्मेवारी	समयावधी
१. नक्सापास दस्तुरमा ५०% छुट	घरधनी	नगरपालिका	न.पा.	२०७१÷७२ आ.ब
२. नक्सापास प्रक्रिया अवधि घटाउने	घरधनी	नगरपालीका	न.पा.	२०७१÷७२ आ.ब
३. World Env. Day को अवसरमा उत्कृष्ट ३ घरधनीलाई सम्मान÷पुरस्कृत गर्ने	घरधनी	नगरपालीका, संघ (UN-HABITAT)	न.पा.	२०७२÷७३
४. घरधनी÷निर्माणकर्मी-हरुलाई अनुशिक्षण÷तालिम प्रदान गर्ने	घरधनी÷निर्माणकर्मी	नगरपालीका, संघ (UN-HABITAT)	न.पा., क्युपेक, नि.य.संघ	२०७१÷७२
नि : शुल्क बिरुवा उपलब्ध गराउने	घरधनी÷संघ संस्था	न.पा, सामु‘÷बन कार्यालय	न.पा., सा.ब.ब का	२०७१÷७२
IPT÷अन्य सेवामा छुट	घरधनी÷संघ संस्था	नगरपालीका	न.पा.	२०७२÷७३
७. घर निर्माणको म्याद १ वर्ष थप गरी ३ वर्षको बनाउने ।	घरधनी÷संघ संस्था	नगरपालीका	न.पा.	२०७२÷७३

Further Plan

Incentive Mechanism

क्रियाकलाप	लक्षित समुह	स्रोत	जिम्मेवारी	समयावधी
८. Rain Water Harvesting Solar System, Biogas प्रविधि प्रयोग गरे (ल.ई) निर्माण खर्चको २५% वा रु १०,००० जुन कम हुन्छ त्यो उपलब्ध गराउने ।	घरधनी	न.पा. UN-HABITAT	न.पा. UN-HABITAT	२०७२÷७३
९. घर निर्माणको ईजाजत २५ दिन भित्र स्वीकृत गर्ने ।	घरधनी	न.पा.	न.पा.	२०७१÷७२
१०. कन्सल्टेन्सी÷डिजायनरलाई नि :शुल्क तालिमको व्यवस्था ।	क.÷डि	न.पा. UN-HABITAT	न.पा. UN-HABITAT	२०७१÷७२
११. उत्कृष्ट क. डि. लाई वार्षिक रुपमा पुरस्कृत÷नविकरण शुल्क मिनाह ।	क.÷डि	न.पा. UN-HABITAT	न.पा. UN-HABITAT	२०७१÷७२
१२. ठेकेदार÷निर्माणकर्मीहरुलाई नि :शुल्क तालिम ।	के.÷नि	न.पा. UN-HABITAT	न.पा. UN-HABITAT	२०७१÷७२
१३. कार्यदक्षताका आधारमा पुरस्कृत ।	के.÷नि	न.पा. UN-HABITAT	न.पा. UN-HABITAT	२०७१÷७२
१४. ठेकेदार÷निर्माणकर्मीहरुको व्यवसायिक प्र. प. नविकरण शुल्कमा ५०% छुट ।	न.पा.	न.पा.	न.पा.	२०७१÷७२
१५. निर्माण सामाग्री उत्पादक÷बिक्रेता लाई सामाग्रीको गुणस्तरको आधारमा पुरस्कृत÷दण्डित गर्ने व्यवस्था ।	न.पा. UN-ABITAT	न.पा.	न.पा.	२०७१÷७२

Capacity Building

क्रियाकलाप	लक्षित समुह	स्रोत	जिम्मेवारी	समयावधी
१. तालिम तथा अनुशिक्षण	१. प्राविधिक (क) ध.न.पा. (ख) कन्सल्टेन्सी (ग) अन्य २.निर्माण व्यवसायी ३. निर्माणकर्मी ४.घरधनी ५. नागरिक समाज, पत्रकार र अन्य सरोकारवालाहरु जस्तै : खानेपानी, विद्युत आदि ।	स्था.वि. मन्त्रालय ध.न.पा, शहरी विकास मन्त्रालय	१. ध.न.पा २.निर्माण व्यवसायी ३.क्यूपेक ४. राजनितिक दल ५.नागरीक समाज	१ वर्ष पहिलो २०७२ आषाढ सम्म
२. जनचेतनामूलक कार्यक्रम संचालन (क) रेडियो तथा टि.भी कार्यक्रम (ख) पत्रपत्रिका (ग) पर्चा, पम्प्लेट (घ) माईकिङ्ग	१. घर बनाईसकेका घरधनीहरु २. नयाँ घर बनाउने घरधनीहरु ३. निर्माण सामाग्री उत्पादक तथा वितरकहरु ४. सम्पूर्ण नगरवासीहरु	UN-HABITATस्था.वि. मन्त्रालय ध.न.पा, शहरी विकास मन्त्रालय, उ.वा. संघ	१. ध.न.पा २. उ.वा. संघ	६ महिना २०७२ पौष सम्म
३. गुणस्तर निर्धारण र स्वर वर्गिकरण	१. प्राविधिकहरु २. घरधनीहरु ३. उत्पादक तथा वितरक	- ध.न.पा, - निर्माण सामाग्री उत्पादक तथा वितरक - प्राविधिकहरु - UN-HABITAT	१. ध.न.पा २. उ.वा. संघ	६ महिना २०७३ आषाढ सम्म

Awareness and Promotional Activities

क्रियाकलाप	लक्षित समुह	स्रोत	जिम्मेवारी	समयावधि
१. सुचना केन्द्र÷डेस्कको स्थापना (Mobile message, electronic communication)	सरोकारवाला सबै	ध.न.पा,UN-HABITAT, नेपाल सरकारका विषयगत कार्यालयहरु	ध.न.पा	क्र अवधि
२. सामुदायिक संस्था, विद्यालय, व्यक्ति पचिालन गर्ने, उ.वा. संघ	”	”	ध.न.पा,UN-HABITAT,SEAM-N,	१ वर्ष सम्म - चौकासिक)
३.प्रशिक्षक प्रशिक्षण तालिम, अन्य तालिम, सेमिनार गोष्ठी (TOT)	स्थानिय भवन निर्माण व्यवसायी र निमीठा, संघ संस्था र सरोकारवालाहरु	”	ध.न.पा,UN-HABITAT, स्थानिय भवन निर्माण व्यवसायी संघ SEAM-N	१ वर्ष सम्म (त्रैमासिक) TOT २०७१ असार मसान्त सम्म
४. भवन नक्सा वास फारममा जानकारी पुस्तिका संलग्न गर्ने	भ्वन निर्माण गर्ने घरधनी	ध.न.पा,UN-HABITAT, DUDBC	ध.न.पा	२०७१ असोज मसान्त सम्म
५.Brochure,पम्प्लेट छपाई तथा वितरण	सरोकारवाला सबै	”	”	६ महिना भित्र
६. रेडियो, टिभी कार्यक्रम उत्पादन र संचालन	”	”” SEAM-N	ध.न.पा र पत्रकार महासंघ	१ वर्ष भरि संचालन ३ महिना उत्पादन

Awareness and Promotional Activities

क्रियाकलाप	लक्षित समुह	स्रोत	जिम्मेवारी	समयावधि
७. हरित आवास सँग सम्बन्धित उत्पादन, निर्माण सामाग्री र प्रक्रियाको गुणस्तर प्रमाणिमकरण	उत्पादक, वितरक प्राविधिक र निर्माणकर्मी	ध.न.पा DUDBC स्थानिय वि. मं.	ध.न.पा DUDBCस्था. परामर्शदाता प्रतिनिधि उ.रा.संघ	सधैँ
८. लेभल छुट्याएर छुट तथा प्रोत्साहनको व्यवस्था	सरोकारवाला सबै	ध.न.पा, र UN-HABITAT	ध.न.पा	त्रमबद्ध रुपमा
९. अध्ययन, अवलोकन भ्रमण -अन्तरदेशीय र अन्तराष्ट्रिय)	सरोकारवाला	ध.न.पा,UN-HABITAT, DUDBC, SEAM-N	ध.न.पा, DUDBC	वर्षमा त्त पटक
१०. न.पा. बाट निर्माण हुने भएका भवन तथा अन्य पूर्वाधारलाई हरित आवास सिद्धान्त बमोजिम गर्न सुरु गर्ने (अरु थप्न सकिने छ छलफलबाट)	उपभोक्ता समुह, सरोकारवाला	ध.न.पा, DUDBCस्था.वि.मं., सरोकारवाला	ध.न.पा	त्रमबद्ध रुपमा

Construction of Green School Building in Pokhara

- Green classrooms with CSEB technolgy in Mahendra High School in Bhalam, Pokhara

(Source: Field visit_UN Habitat Training Pokhara_Dec 2014)

Construction of Green Building in Pokhara

- Green buildings with CSEB, bamboo, UPVC in SOS School in Pokhara

(Source: Field visit_UN Habitat Training Pokhara_Dec 2014)

Construction of Green School Building in Pokhara

- Green buildings with solar PV panel, collector in SOS School in Pokhara

(Source: Field visit_UN Habitat Training Pokhara_Dec 2014)

Housing experience from Costa Rica

“Organized self-help housing and management (OSHM) - an experience from Costa Rica”

- An article published in VAASTU vol.9 in 2007

Housing experience from Costa Rica

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- an experience from Costa Rica"

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ENERGY EFFICIENT PLANNING APPROACH

- CAPE TOWN, SOUTH AFRICA

- ***Build a more compact, Resource-efficient city***
- ***Develop a more Sustainable Transport System***
- ***Employee trip-reduction program***
- ***Building retrofits***
- ***Behavior change interventions***
- ***Street lighting and traffic lighting***

Figure : Electricity saving tips(*http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/Moving_Mountains_Energy+CC_booklet_2011-*

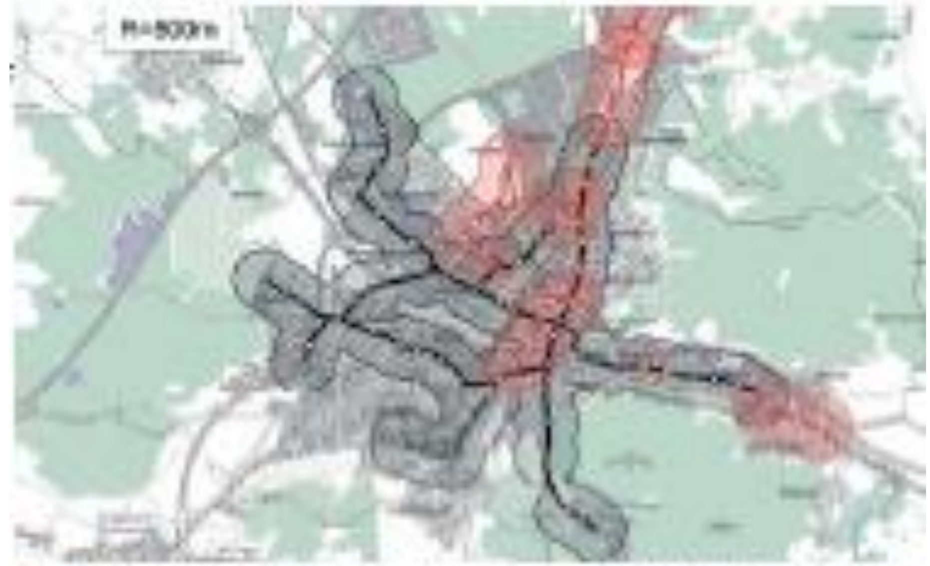
FREIBURG: ECO-CITY OF GERMANY

Energy Efficient Planning Approaches:

– *Expansion and Integration of Public Transit*

– *Making Food and Daily Needs easily Accessible without Driving*

– *Integration of Passive house standards*



CHANDIGARH: SOLAR CITY

Figure : Rooftop solar PV *(Source: http://www.rtcc.org/indias-government-urgedto- back-faltering-solar-cities-plan/, 2013)*

City has 50kW grid interactive rooftop solar PV installation, costing Rs 90.40 lakh ($1.5 million)

• A similar 100kW installation at the city’s main prison was also connected.

• The rooftop systems are grid connected where excess power will be sent to the grid while power can be drawn from the grid in case of shortage.

• According to The Ministry of new and renewable energy (MNRE) officials, the potential of rooftop PV systems could be at least 20GW by 2015.

URBAN VILLAGE PROJECT: ECO-CITY OF OAKLAND

- **Energy Efficient Planning Approaches**

– ***Access by proximity***

– ***Development right transfer***

– ***Mixed Land use***

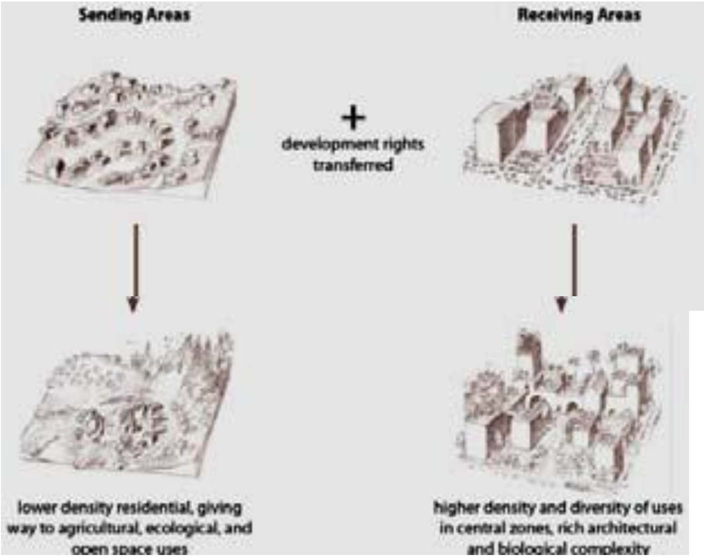
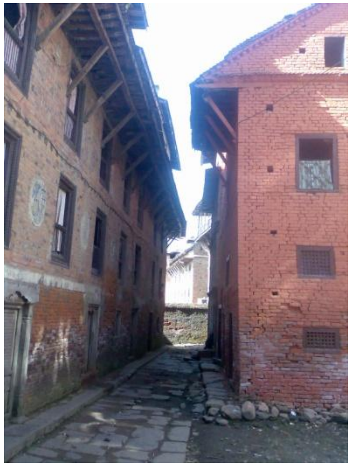


Figure : Development Right Transfer*(Source: http://www.ecocitybuilders.org/wpcontent/uploads/2010/11/EcocityMappingFinal.pdf)*

Energy Efficient Traditional Buildings and Settlement Patterns of KTM



- **Traditional residential building - 1 to 2 C warmer during**
- **winter and 1 to 2 C cooler during summer than modern residential buildings.**

- **The planning of traditional settlement such that it encourages all urban facility in walking distance.**

- **The residential neighborhood and private residential square were planned with linear alleys and courtyard system,**

- **which is often opportunity to use the climatic factors like sun, wind, humidity etc.**

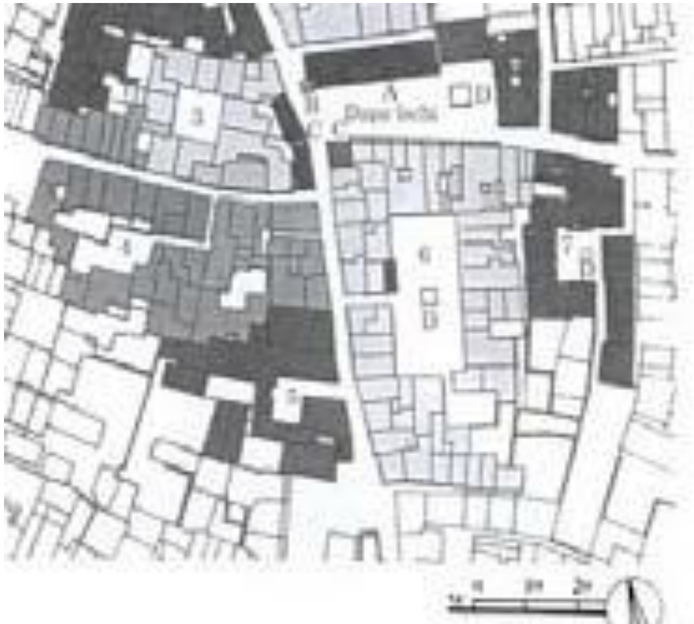


Figure : Dupat tole settlement cluster
(Source: Funo, 2007)

Influence of Mixed Land Use on Energy Efficiency

- People lived at very high densities because the amount of space required for daily living and movement

- Between different activities was determined by walk ability and the scale of the human body.

- The benefits of mixed land use in the aspect of energy efficiency are:

– Reduced distances between housing, workplaces, retail businesses, and other destinations

– More compact development

– Pedestrian and bicycle-friendly environments

Influence of Eco city Framework on Energy Efficiency

- **An eco-city allows people to choose walking, biking, or mass transit for**

most transportation needs; recycle or reuse most of their wastes; grow

much of their food; live in low-carbon, energy and resource

efficient buildings.

- **The building stock in Eco City (Nieminen, 2011) has**

– 75% lower building envelope heat losses

– 70% lower ventilation and infiltration heat losses

– 50% lower water consumption

– 50% lower water heating demand

– 30% lower cooling demand

-

Some credits of IEFS that contribute energy efficinecy:

– ***Access by Proximity: encourage compact city, walking & transit access***

– ***Clean and safe water : energy saving in water treatment & supply***

– ***Clean and renewable energy***

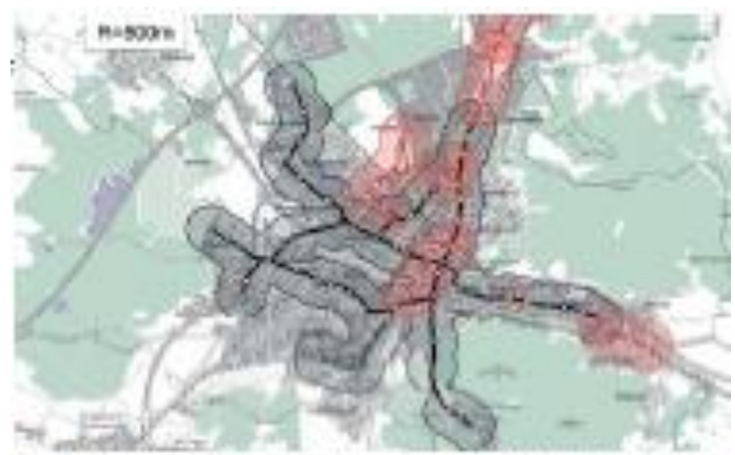


Figure : Extension of public transport network (Source: Making Cities Energy Efficient, 201

Influence of LEED on Energy Efficiency

• LEED Green Building certification System evaluates energy and environmental performance from a whole building perspective over a building's life cycle.
• LEED buildings are, on average, 25-30% more energy efficient.

• LEED credits that contribute energy efficiency:
– ***Smart Location and Linkage: established communities & near public transit***
– ***The Neighborhood Pattern and Design: promote walkability***
– ***Public Transportation Access: within ¼ mile walking distance from bldg to bus stop***
– ***Community Connectivity: within ½ mile of neighborhood -10 basic services***
– ***Mixed-Use Neighborhood Centers***
– ***Low-Emitting and Fuel-Efficient Vehicles***
– ***Minimizing Heat Island Effect***
– ***Water Use Reduction***
– ***On-site Renewable Energy***
– ***Building Reuse***
– ***Materials Reuse***

Recent Approaches to Energy Efficient Planning
of Towns and Neighborhood

• **Integrated Transport – Land Use**

– Planning for more compact and connected, well integrated with public transport towns and neighborhood

– Create mixed land use so that all the services and facilities may accessible within the shorter distance

– Develop Transit Oriented Development

– Extend of public transport network to cover all citizens with walking distance.

– Improve on public transport

– Develop a more Sustainable Transport System

– Provide energy efficient alternatives to automobile travel for trips outside the neighbourhood

– Increase the convenience of public transit

– Soft mobility (people movers, bicycles, etc.) and shared mobility (carpooling) offers.

– Pedestrianize to certain areas esp. core area of the town

– Create km per hour(Kph) zones

– Parking pricing schemes

Recent Approaches to Energy Efficient Planning of Towns and Neighborhood…

- **Improving Urban Design**

– Safe and attractive pathways with street lighting
– Easy crossings
– Connected pavements/ sidewalks
– Improved landscaping
– Bicycle paths and bicycle parking spaces
– Shopping facilities accessible on foot; and neighborhoods supported by public transport
– Easy access to work, retail and other services.
– Availability and accessibility of green spaces, parks, spaces for social interaction and recreational and sports facilities

Recent Approaches to Energy Efficient Planning of Towns and Neighborhood…

• Improving infrastructures and urban services

– Gravity fed water supply

– Improvement in the quality of the water supplied

– Public lighting networks

– Streamlined management of public lighting to reduce energy consumption

– waste and wastewater management. Energy recovered from waste and wastewater eg,

- heat recovery from wastewater networks for producing heat and refrigerant

Recent Approaches to Energy Efficient Planning of Towns and Neighborhood…

- **Other approaches**

– Produce and consume renewable energy

– Innovative water and waste treatment (recycling, energy recovery, desalination, etc.)

– Energy-positive buildings and neighborhoods

– High-efficiency techniques and appliances eg, high efficiency water pumping, energy efficient street lighting, traffic lighting etc.

– Apply Ecocity framework or Green building rating system

– Behaviour change interventions through awareness

– Development right transfer programme

– Building retrofits

– Maximize of the efficient use of waste and material resources

– Increase the useful life of buildings and materials

THANK YOU

Dr. Sushil B. Bajracharya

Energy in Sustainable Urban and Rural Planning

Sustainable approaches in settlement planning

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S. Singh

CONTENT

- The significance of sustainable approaches in urban planning
- Key planning principles: sustainable/ecological perspectives
- The new paradigm: Eco city and similar approaches
- The elements of eco city
- Eco city elements in traditional settlements of Kathmandu valley
- Eco city practices across the globe (next class)

SIGNIFICANCE

- The 21st century is being referred to as the **age of the city**.
- The **challenge** of realizing an **affluent life** without increasing the burden on **urban environments** is a common issue for all humanity.

THE TREND

- **Demographic trends** claim that the majority of the **future population growth** in the world is likely to be experienced **in small and medium size cities** in the **developing countries** of Asia and Africa, many of which are prone to various kinds of disasters.
- A United Nations study (UN/ISDR *2004*) revealed that **75% of the world's population** lives in areas that have been **affected at least once by earthquake, tropical cyclone, flood, or drought between 1980 and 2000**.

SIGNIFICANCE

- On average, about **75 percent of global economic production takes place in cities**, and in **developing countries**, the corresponding share is now rapidly increasing with **the urban share of national GDP already surpassing 60 percent.**
- Calculations already show that, if developing countries urbanize and **consume resources as developed countries have done**, an ecological resource base as large as **four planet Earths** would be needed to support their growth. (Suzuki, Dastur, Moffatt, & Yabuki, 2009)
- Humanity is increasingly **living beyond our means** - we currently consume **50% more natural resources** than the **Earth's ecosystems can replenish.** (WWF)

SIGNIFICANCE

The **urban environment** in the cities:

- constitutes basically of the **physical, economic, social and cultural environment**
- that often **conflicts** with the **natural environment** and **natural ecology** in many aspects
- leading to **ecological and sustainability problems.**

SIGNIFICANCE

- The **rapid trend of urbanization** and the **growing number of cities** which is the global phenomenon **cannot be curbed**
- The **future city planning initiatives** need to find ways and means to find the solutions that deal with this phenomenon and **maintaining the ecological balance** at the same time.

Key planning principles and parameters

Planning of cities have been guided by various factors in different periods in the history of planning of urban settlements.

Mostly guided by:

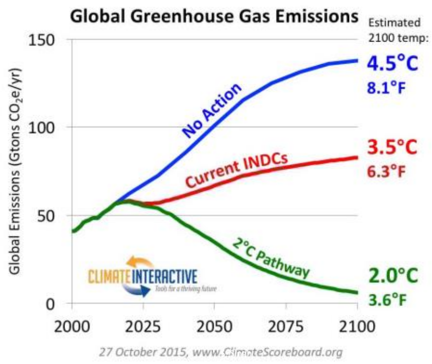
- **well being of human beings**
- **security** from the harmful elements
- **food security**
- **prosperity**
- **spiritual beliefs** in the ancient times

The new paradigm

- **"Sustainable development"** has become the new paradigm in global efforts towards economic development since the **Brundtland commission** published a report "our common future" in 1987
- "**development** that meets the **needs of the present**, without compromising the **ability of future generations to meet their own needs**" (WCED, 1987)
- Eco cities, sustainable cities, healthy cities, safer cities, cities without slums, smart cities, energy conscious cities, clean cities, and green cities, etc.
- Healthy communities, appropriate technology, community economic development, social ecology, the green movement, bioregionalism, native world views
- Low carbon city, Zero carbon city, Green capitalism

- The main objective of the **annual Conference of Parties (COP)** is to review the Convention's implementation.
- The first COP1 took place in Berlin in 1995
- COP3 Kyoto Protocol
- COP11 Montreal Action Plan
- COP17 in Durban: Green Climate Fund was created
- COP21 held in Paris (30 Nov-11 Dec 2015) with the aim of keeping global warming below 2°C. (United Nations Conference on Climate Change, 2015).

"Intended Nationally Determined Contribution" (INDC)



- At the United Nations Sustainable Development Summit on 25 September 2015, world leaders adopted the **2030 Agenda for Sustainable Development**, which includes a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030.

ECO CITY

- <u>**Ecocity**</u> is quite a <u>**recent paradigm**</u> considered by the planners in trying to tackle the complex relationship between the **human environment** with the **natural ecosystem.**
- According to the declaration of the <u>**World Ecocity Summit 2008 in San Francisco**</u>, an ecocity is an "**ecologically healthy city"**.

Ecocity and its advocacy

- The ecocity concept has been started by **Richard register** founding president of Urban Ecology (1975) and founder and current president of Ecocity Builders (1992).
- The publication of a book **"Eco-city Berkeley- Building cities for a healthy future"** in 1987 and some other books explaining <u>how cities can be built considering nature as an integral part of the process of planning a settlement.</u>

Ecocity approaches and its advocacy

- Register stresses on rebuilding our cities <u>**"in balance with nature",**</u> stresses on **"as we build, so shall we live**".
- "When we build the <u>**automobile sprawl infrastructure**</u>, we create a <u>**radically different social and ecological reality**</u> than if we build closely knit communities for pedestrians" (Register, 2006).

Ecocity approaches and its advocacy

- The Working definition adopted by <u>**Ecocity Builders and the International Ecocity Standards advisory team, Vancouver, Canada 2010**</u> can be stated as <u>"An Ecocity is a human settlement modeled on the **self sustaining resilient structure and function of natural ecosystems.**</u>
- The ecocity provides healthy abundance to its inhabitants <u>**without consuming more (renewable) resources than it produces**</u>, without <u>**producing more waste than it can assimilate**</u>, and <u>**without being toxic to itself or neighboring ecosystems.**</u>

Ecocity approaches and its advocacy

- Several others have propagated the concept of ecocity.
- **David Engwicht (1992)** in **"Towards an Eco-City",** mentions that a city is "an invention for <u>**maximising exchange**</u> and <u>**minimising travel**</u>". He advocates 'eco-cities' where people can move via foot, bicycles and mass transit and interact freely without fear of traffic and toxins.
- The five principles of an ecocity according to **Prof. Tiwari** are a) **green** city, b) **wet** city, c) **cool** city, d) **disposability** and e) living with **other beings**.

Ecocity approaches and its advocacy

- **Rodney R. White** describes the eco-city as '**a city that provides an acceptable standard of living for its human occupants without depleting the ecosystems and biochemical cycles on which it depends';** he believes it to be the most durable kind of settlement that humans can build (2002).
- **Rüdiger Wittig** describes an eco-city as the **one that minimizes the difference between the characteristics of a city and characteristics of the natural ecosystem** and the result of that would be a **reduced ecological footprint of the city** (2007).

ECO CITY

- According to World Bank "Eco2 Cities" report: "Ecological cities **enhance the wellbeing of citizens and society** through **integrated urban planning and management** that **fully harnesses the benefit of ecological systems,** and **protects and nurtures these assets for future generations**."

Ecocity approaches and its advocacy

- Eco city however is based on a **number of earlier spatial planning models** starting from **Garden city of Ebenezer Howard** and the later theories of **Patrick Geddes, Lewis Mumford, Ian Mc Harg, Christopher Alexander and others** through the course of the twentieth century.

Ecocity approaches and its advocacy

Garden cities of tomorrow (1902)

- **Howard** has laid emphasis on the synthesis of town and country which he terms as the **"town-country magnet"** where cities benefit from the urban and rural characters combined together.

Ecocity approaches and its advocacy

- **Integrating nature into the cities** and **zoning into different uses and creating greenbelts as way of delimiting the growth**
- **Letchworth and Welwyn** in the United Kingdom laying the foundation for modern city planning.
- Frank Lloyd Wright's 'Broadacre City'

ELEMENTS OF ECOCITY

The declaration from the Ecocity World summit in San Francisco defines the necessary elements of an Ecocity as follows:

1. **Ecological security**
2. **Ecological sanitation**
3. **Ecoscape integrity**
4. **Ecological industrial metabolism**
5. **Ecological awareness**

elements

Ecological security

- Clean air
- Safe, reliable water supplies,
- Food security
- Healthy housing and workplaces
- Municipal services and protection against disasters for all people.

LITERATURE REVIEW

Ecoscape (ecological-landscape) integrity

– arrange built structures, open spaces, infrastructure, and natural features to **maximize biodiversity.**

– **maximize accessibility** of the city for all citizens while **conserving energy and resources** and alleviating such problems as automobile accidents, air pollution, hydrological deterioration, heat island effects and global warming.

FOCUS OF LITERATURE REVIEW

Ecological awareness

help people **understand their place in nature**, cultural identity, responsibility for the environment, and help them change their **consumption behavior** and **enhance their ability** to contribute to maintaining **high quality urban ecosystems.**

LITERATURE REVIEW

3. DIMENSIONS OF ECOCITY

The **International Ecocity Framework and Standards (IEFS) initiative**, launched in February 2010, by **Ecocity Builders** and an **international committee of expert advisors**.

The IEFS seeks to provide an **innovative vision** for an **ecologically-restorative human civilization** as well as a practical methodology for assessing and guiding the achievement of such vision through the lens of the Ecocity.

LITERATURE REVIEW

The Ecocity Framework: 15 dimensions of ecocity

urban design feature

1. access by proximity

bio-geo-physical conditions

2. clean air
3. clean and renewable energy
4. healthy and accessible food
5. responsible material resources
6. healthy soil
7. clean and safe water

LITERATURE REVIEW

ecological imperatives

8. healthy biodiversity
9. earth's carrying capacity
10. ecological integrity

socio-cultural dimensions

11. healthy culture
12. community capacity & participation
13. education
14. healthy and equitable economy
15. well-being- quality of life

Key ecological principles

URBAN ECOLOGY PRINCIPLES	MELBOURNE PRINCIPLES	OPL PRINCIPLES

[1] Urban ecology 1996
[2] (UNEP, 2002)
[3] WWF One planet living (OPL) principles

Eco city elements in the traditional settlements of Kathmandu valley

- Kirtipur
- Sankhu
- Khokana

Post disaster scenario

In most of the traditional settlements like Sankhu, Khokana, Bungamati, Kirtipur etc the impact was intense:

- Buildings mostly load bearing /mud mortar damaged
- Roads blocked
- Damage to Heritage buildings (temples and others)
- Damage to traditional water sytem
- Loss of identity: street facade
- Loss of lives
- Impact on livelihood

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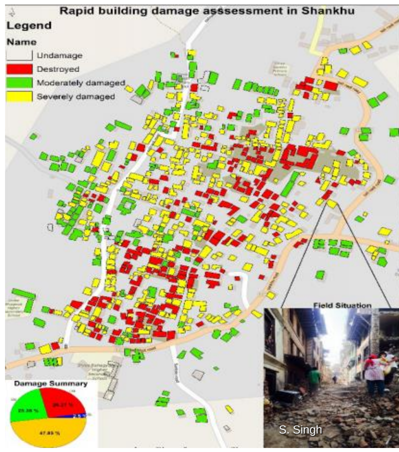


SANKHU

More than 95% of the houses damaged
115 casualties
(Sankhu Reconstruction Committee)

Map: ICIMOD 27 April 2015

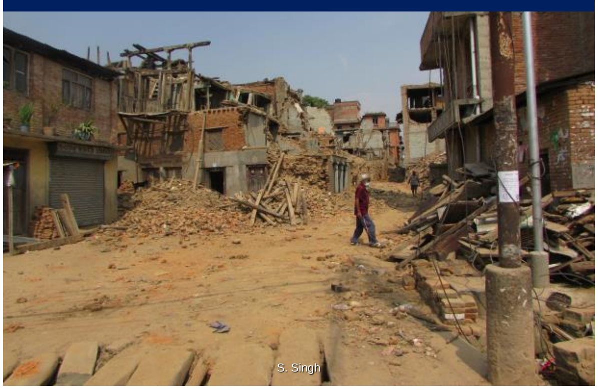
Roads blocked: Khokana

SANKHU

Blocked roads

Roads blocked: sankhu

Loss of identity : street façade (sankhu)

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Damage to water infrastructure: ponds, wells, stone spouts
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Women and elderly most vulnerable
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Substandard temporary shelters
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Drainage and other issues in temporary shelters

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Temporary shelters built on vulnerable areas

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Post disaster scenario

Does it mean:

- That the traditional settlements were not disaster resilient?
- That the traditional settlements were not sustainable?
- That the traditional building technology is neither sustainable nor disaster resilient?
- That the settlements cannot be regenerated?

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Post disaster: the positive side

Open spaces: saved lives and provided space for immediate shelter

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Immediate relief and basic services

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Even water bodies provided space for immediate shelter at the time of disaster

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Strong community bonding helped in bouncing back quicker

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Dismantling and debri management on local initiatives

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Recycling of bricks in mud mortar

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ECO CITY ELEMENTS

The traditional settlements of the Valley (dating back to the kirat/licchavi/malla periods) can be considered as good examples of settlements that are:

– planned in balance with nature (sustainable)
– are disaster resilient

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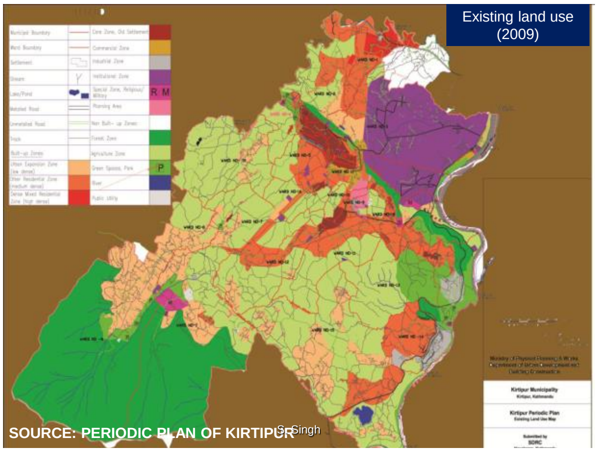

SANKHU: Settlement pattern and land use

Settlement was planned for 1000 inhabitants in balance with nature (manishail mahavadhan)

River flowing from the Manichud mountain (Sali nadi and others)

Rich alluvial soil surrounding the settlement

Forest resources on all sides:

- East: Thugun
- West: Salagun
- North: Gubhagun
- South: Itagun

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THE BUILT FORM

Compact settlement on tar land (kirat period) preserving the agricultural land and forest

The built form based upon cosmic principles and sustained by socio cultural and religious traditions

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public/ semi public open spaces/ courtyards in compact built up area improve the **micro climate**, are spaces that are **ecologically significant**, enhance **disaster resilience** within the settlement and strenghten **community bonding**

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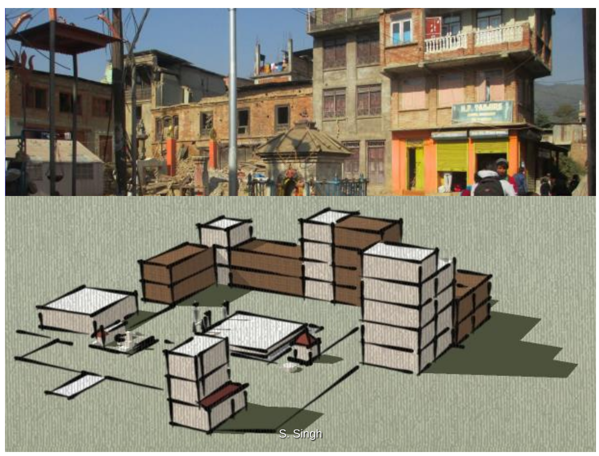

The open jointed paving of the streets and public/ semi public open spaces contribute to recharging of groundwater

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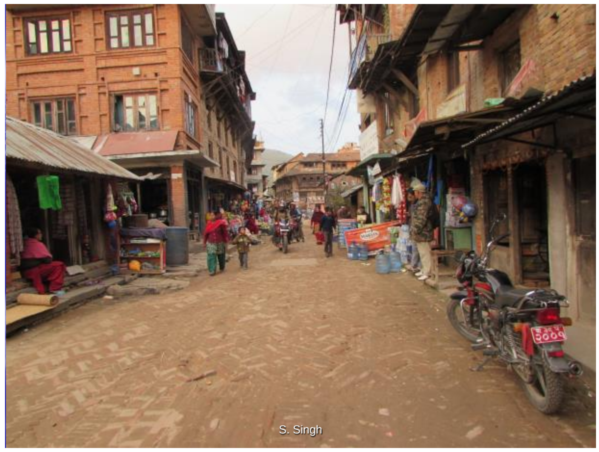

Ponds: for recharging water for stone spouts at lower level

Socio cultural and religious tradition for sustainability

- **Temples/ deities** for protection of **natural resources** like forest, rivers, water bodies etc.
- Festivals linking the inner deities with the peripheral power piths and deities located for the protection of natural resources.

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Temples located on the river bank of Sali nadi (month long festival of madhavnarayan (swosthani)

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Temples located on the river bank of Sali nadi

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Bajrayogini Temple located amidst the forest for its protection

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Socio-cultural practices leading to sustainable water management: (sithi nakha for cleaning wells)

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Role of biodiversity well understood by the traditional societies: (Nagpuja)

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Traditional technology: sustainable

The building materials mostly used are **bricks on mud mortar**, with wooden doors and windows and tile roofing which are mostly natural materials that do not contribute to global warming.

The buildings have a certain lifetime depending upon the life period of the materials that were used; hence without maintenance reconstruction these are bound to decay.

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Traditional technology: sustainable/ resilient

Disposability and perishability is also a significant aspect of sustainability. Disposal without much stress on nature.

Due to the use of mud mortar the recycling potential of bricks much higher.

The restriction of heights : residences could not be higher than the temples (consideration for earthquake resistance and uniformity of street façade)

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Walls are generally made **thick** so that the centre of gravity of the wall is within the wall when slight horizontal displacement occurs apart from providing good insulation.

Frog in the bricks is also a kind of interlocking mechanism which holds the mortar and the bricks when there is shaking.

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Addition of floors (with RCC roofing in many cases)

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Most buildings from the ancient periods without any maintenance and renewal

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observations

- The analysis of the traditional settlement planning shows that the settlements have been well planned both form the ecological sustainability and disaster resilience perspectives
- These are the **basic parameters** that are key to most of the planning concepts of the twenty first century like the eco city, green city etc.
- The **philosophy** behind the planning of traditional settlements can be adapted to suit the modern context so that the traditional settlements can be regenerated and can be developed into the modern day eco cities that are also disaster resilient.

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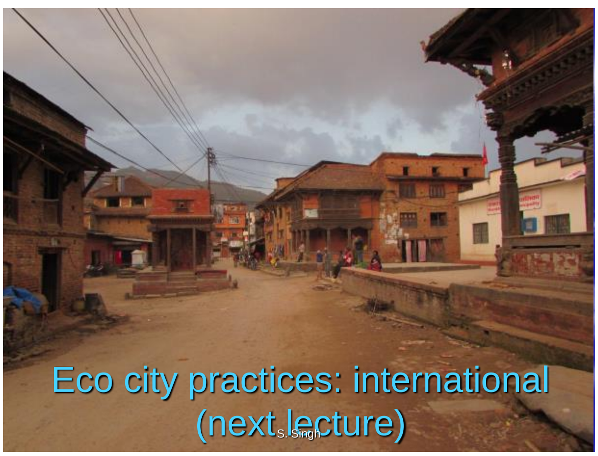

Urban and Rural Planning

By Dr. Sudha Shrestha

Definition of PLANNING

Planning is the act or process of making or carrying out plans

specifically **:**

the establishment of

- **goals,**
- **policies,**
- **and procedures**

for a social, cultural and economic (political, environmental etc.)

unit <city *planning*> <business *planning*>

Planning.

- A basic management function involving formulation of one or more detailed plans to achieve optimum balance of needs or demands with the vailable resources.

- The planning process

(1) identifies the goal and **objectives** to be achieved

(2) (2) formulates **strategies** to achieve them,

(3) arranges or **creates** the means required, and

(4) implements, **directs**, and **monitors** all steps in their proper sequence.

Planning

- In organizations, planning is a management process, concerned with defining goals for company's future direction.
- and determining on the missions and resources to achieve those targets.
- To meet the goals, managers may develop plans such as a business plan or a marketing plan.
- Planning always has a purpose. The purpose may be achievement of certain goals or targets.
- Main characteristics of planning in organizations are:

Planning

- The concept of planning is to identify what the organization wants to do by using the five questions, which are as follows,
- Where we were in the past?
- "where are we today ?
- Where are we going?
- Where do we want to go?
- How are we going to get there?..."

Planning

- It is "an anticipatory decision making process" that helps in coping with complexities.
- It is deciding future course of action from amongst alternatives.

Planning.

- It is a process that involves making and evaluating each set of interrelated decisions.
- It is selection of missions, objectives and "translation of knowledge into action."
- A planned performance brings better results compared to an unplanned one.

Planning

- A manager's job is planning, monitoring and controlling.
- Planning and goal setting are important traits of an organization.
- It is done at all levels of the organization.
- Planning includes the plan, the thought process, action, and implementation.

Planning.

- Planning gives more power over the future. Planning is deciding in advance what to do?, how to do it? when to do it? and who should do it?
- It bridges the gap from where the organization is? to where it wants to be?
- The planning function involves establishing goals and arranging them in logical order.

Planning process

- Example of planning process framework.

Patrick Montana and Bruce Charnov outline a three-step result-oriented process for planning:

- Choosing a destination
- Evaluating alternative routes, and
- Deciding the specific course of your plan.

Planning Process

- Planning increases the efficiency of an organization.
- It reduces the risks involved in modern business/city planning activities.
- It utilizes with maximum efficiency the available time and resources.

Planning in public policy

- Public policy planning includes environmental, land use, regional, urban and spatial planning.
- In many countries, the operation of a town and country planning system is often referred to as "planning" and the professionals which operate the system are known as "planners".

Planning.

- The control of development by a local authority,
  through regulation and licensing for land use changes and building.

Land-Use Planning

Land Use Planning

- **Land-use planning** is the general term used for urban planning encompassing various disciplines which seek to order and regulate land use in an efficient and ethical way, thus preventing land use conflict.
- Governments use land-use planning to manage the development of land within their jurisdictions.
- The governmental unit can plan for the needs of the community while safeguarding natural resources.

Land Use Planning

- It is the systematic assessment of land and water potential, alternatives for land use, and economic and social conditions in order to select and adopt the best land-use options
- Often one element of a comprehensive plan a land-use plan provides a vision for the future possibilities of development in neighborhoods, districts, cities, or any defined planning area.

Land Use Planning

- In the United States, the terms land-use planning, regional planning, urban planning, and urban design are often used interchangeably, and will depend on the state, county, and/or project.
- Despite confusing nomenclature, the essential function of land-use planning remains the same whatever term is applied.

Land Use Planning

- The Canadian Institute of Planners offers a definition that land-use planning means the scientific, aesthetic, and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of urban and rural communities.
- The American Planning Association states that the goal of land-use planning is to further the welfare of people and their communities by creating convenient, equitable, healthful, efficient, and attractive environments for present and future generations.

Land Use Planning

- Land-use planning often leads to land-use regulation, which typically encompasses zoning. Zoning regulates the types of activities that can be accommodated on a given piece of land, as well as the amount of space devoted to those activities, and the ways that buildings may be situated and shaped.

History of Land-Use Planning

- The ambiguous nature of the term "planning", as it relates to land use, is historically tied to the practice of zoning.
- Zoning in the US came about in the late 19th and early 20th centuries to protect the interests of property owners.

Land Use and Zoning

- One interpretation of the taking clause is that any restriction on the development potential of land through zoning regulation is a "taking".
- A deep-rooted anti-zoning sentiment exists in America, that no one has the right to tell another what he can or cannot do with his land.
- Ironically, although people are often averse to being told how to develop their own land, they tend to expect the government to intervene when a proposed land use is undesirable.

Urban Planning

Urban Planning

- Urban planning is a technical and political process concerned with the use of land, protection and use of the environment, public welfare, and the design of the urban environment, including air, water, and the infrastructure passing into and out of urban areas such as transportation, communications, and distribution networks.
- Urban Planning is also referred to as urban, regional, town, city, rural planning or some combination in various areas worldwide.
- Urban planning takes many forms and it can share perspectives and practices with urban design.

Urban Planning

As a function of architecture	As a function of city planning
Involves preparation of different types of plans, site planning or project design as a 'product', i.e., Chandigarh by Le Corbusier;	Considers social, environmental, and economic factors and the ways they are changing in urban system and then integrate inputs from diverse sources for functional, coherent and visually appealing built environment creation;
Involves forming and manipulating spaces;	Programs – capital investment program, new town and housing program, downtown revitalisation program, etc.;

Urban Planning

As a function of architecture	As a function of city planning
Focuses on visual and aesthetic principles and has a notion of spatial quality.	Policies – broad statement of collective intent that influence specific decisions made individually or collectively, e.g., historic preservation, preservation of old neighbourhood, etc; Regulations and guidelines – not mandatory but provides some options, e.g., guidelines for facade treatment or building bulk, etc.

Why Urban Planning/City Planning ?

- Dead city – streets mainly for vehicular traffic and buildings with blanks walls.
- Wastage of energy and resources – living, working and shopping places are far away and not possible without cars.
- Public space as waste or no man's lands - Spaces between buildings and other open spaces created for community are not functional and people do not use them.

Why Urban Planning/City Planning ?

- Social crime increases – the built form and streetscape encourages such activities;
- Anti-urbanism and anti-humanism city or built form
- Architectural zoo – many distinct buildings but without coherent, visual and functional relations.

Anti pedestrian road

New Paradigm in Architecture and Urban Planning

Catalyst by:

- Deindustrialisation, corporatisation, globalisation of economy and international investment;
- Change in economic base from manufacture to information and service oriented;
- Competition for city image, high quality urban space equipped with modern telecommunication systems;
- Development of public private partnership and negotiation in planning and urban development

History of Urban Planning

History of Urban Planning

- There is evidence of urban planning and designed communities dating back to the Mesopotamian, Indus, Valley and Egyptian civilizations in the third millennium BCE.
- Archeologists studying the ruins of cities in these areas find paved streets that were laid out at right angles in a grid pattern.
- The idea of a planned out urban area evolved as different civilizations adopted it. Beginning in the 8th century BCE, Greek city states were primarily centered on orthogonal (or grid-like) plans.

History of Urban Planning

- The ancient Roman, inspired by the Greeks, also used orthogonal plans for their cities.
- City planning in the Roman world was developed for military defense and public convenience.
- The spread of the Roman Empire subsequently spread the ideas of urban planning.
- As the Roman Empire declined, these ideas slowly disappeared. However, most large cities in Europe still held onto the planned Roman city center.
- Most cities in Europe, from the 9th to 14th centuries, grew organically and sometimes chaotically.

History-Urban Planning

- The Renaissance in Europe started to bring back some of these planning and design ideas.
- During the Enlightenment period, several European rulers ambitiously attempted to redesign capital cities.
- During the Second French Republic, Baron Georges-Eugene Haussmann, under the direction of Napoleon III, redesigned the city of Paris into a more modern capital, with long, straight, wide boulevards.

Urban Planner

- An urban planner is a professional who works in the field of urban planning for the purpose of optimizing the effectiveness of a community's land use and infrastructure. They formulate plans for the development and management of urban and suburban areas, typically analyzing land use compatibility as well as economic, environmental and social trends.

Urban Planner

- In developing the plan for a community (whether commercial, residential, agricultural, natural or recreational), urban planners must also consider a wide array of issues such as Energy efficient, sustainability, air pollution, traffic congestion, crime, land values, legislation etc.

Urban Planners

- The importance of the urban planner is increasing throughout the 21st century, as modern society begins to face issues of increased population growth, climate change and unsustainable development. An urban planner could be considered a green collar professional.

Comprehensive planning

- Comprehensive planning is generally known as strategic planning or visioning.
- It is usually accompanied by public consultation peoples participation.

Comprehensive planning

- Comprehensive planning is a process that determines community goals and aspirations in terms of community development.
- The outcome of comprehensive planning is the Comprehensive Plan which dictates public policy in terms of transportation, utilities, land use, recreation, and housing etc.

What is a comprehensive plan?

- A comprehensive plan is a local government's guide to community physical, social, and economic development.
- Comprehensive plans are not meant to serve as land use regulations in themselves; instead, they provide a rational basis for local land use decisions with a twenty-year vision for future planning and community decisions.

Comprehensive planning

- The Comprehensive Planning Law does not mandate how a local community should grow, but it requires public participation at the local level in deciding a vision for the community's future.
- The uniqueness of individual comprehensive plans reflects community-specific and locally driven planning processes.

Comprehensive planning

- While a local government may choose to include additional elements, a comprehensive plan must include AT LEAST all of the nine elements below as defined by the comprehensive Planning Law (International case)

- Issues and Opportunities
- Housing
- Transportation
- Utilities and Community Facilities

Comprehensive planning

- Agricultural, Natural and Cultural Resources
- Economic Development
- Intergovernmental Cooperation
- Land Use
- Implementation

ECO city practices

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What are sustainable cities?

cities that provide people **with high quality living environment** without using **huge amounts of natural resources.**

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What are sustainable cities?

Sustainability involves finding ways to design cities that makes them **good places to live** as well as being more **efficient**

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Cycling

- Does not require fossil fuel
- Use less space
- Improves people's health

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As a result

- City can be less spread out (less urban sprawl)
- Air quality is better
- Improved quality of life

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A HEALTHY LIVING ENVIRONMENT

Cycling is an example of how something sustainable can also produce spaces that are more attractive places and better quality of life for the residents

key activities on energy in cities

- 7 billion+ people on earth: energy consumption!
- Key challenge: reducing reliance on burning of fossil fuel
    - Energy in buildings
    - In transportation
- by new technologies and by changing the ways in which people behave in cities

key activities on energy in cities

- Cities are also becoming place where they produce their own renewable energies
- Eg encouraging home owners to install solar panels (subsidization)

key activities on mobility in cities

- Getting people **out of their cars** and promoting other forms of transport like **cycling, walking**
- Investing in **mass transport** like LRT, bus networks etc which are **more efficient** in terms of **occupying less space** and **less fuel per passenger**

key activities on mobility in cities

- The way in which cities are planned influences how people get around (mobility)
- In USA in 1970's and 80's cities sprawled across a large area with low density suburban areas
- Low population density and huge distances making buses and railways uneconomical
- Motor cars became the only way to get around

key activities in buildings

- **Buildings** use a **majority of energy** in the cities either in **cold or hot climates** for heating and cooling
- Priority: encourage energy efficient buildings:
  - Passive heating and cooling (design)
  - Retrofitting for insulation (new technologies)
  - Solar (alternative energies)

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The water-sewage connection

The conventional way:

Bring **water into the city** – storage, diversion, pipe, pump, treat – from further and further away.

Flush and carry the **waste out of the city** – pipe, pump, divert, treat – further and further away.

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The current paradigm – water supply

More water supplied = More waste water generated = more costs for treatment = Unsustainable

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Way Forward (Water sensitive urban design)

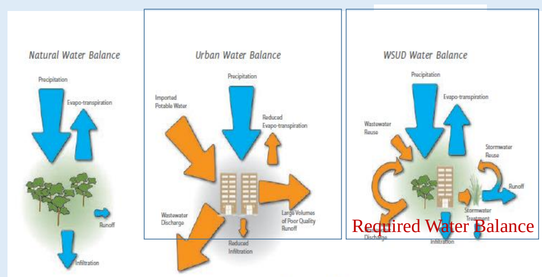

Figure 5 — The Urban Water Cycle showing changes to the natural water cycle with traditional urban development and with WSUD (Hoban and Wong, 2006)

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key principles

1. Protect Natural Systems
   Promoting and protecting natural waterways as ASSETS
2. Integrate Storm Water Treatment into the Landscape
   Use storm water in the landscape
   Leverage its aesthetic qualities within parklands and walking paths, making use of natural topography
3. Protect Water Quality
   Improve the quality of water draining from urban developments into receiving environment, use filtration and retention
4. Reduce Runoff and Peak Flows
   Reduce peak flows from urban development by local detention measures
   Minimize impervious areas
5. Add Value While Minimizing Development Costs
   Minimize the drainage infrastructure costs

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features

- Rainwater harvesting
- Storm water systems
- Grey water recycling
- Waste water recycling
- Demand management strategies
  - leakage management and encouraging water efficiency through behavioural change
  - increased uptake of water efficient appliances

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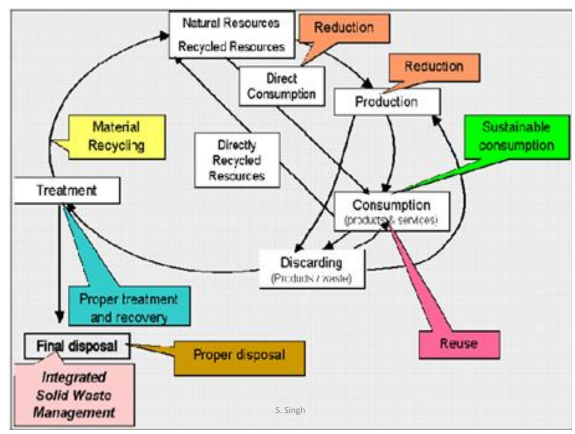
Need an alternative paradigm

• Centralised, government's responsibility – unsustainable	• Decentralised, ownership is spread out – more sustainable
• Rights without responsibility - wasteful use	• Responsibility based, prudent use
• Large financial investments	• Low financial investments – as low as Rs. 5000 for a house
• Negative hydrological interventions (groundwater depletion, flooding)	• Positive hydrological interventions (aquifer recharge, arrests flooding, improves water quality)
• Sourcing from distant hinterlands – externalises water scarcity, breeds conflicts, irresponsible attitudes;	• People look after their water, local water resources
• High level of technology needed – to transport, treat, prevent leakages, regulate flows, meter and collection	• Low level technologies
• Energy intensive	• Energy saving

INTEGRATED SOLID WASTE MANAGEMENT

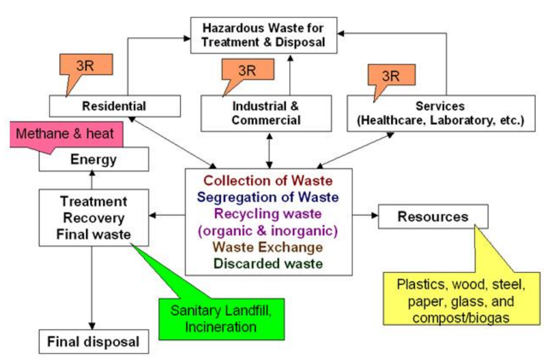
Lifecycle-based Integrated Solid Waste Management

- based on lifecycle assessment of a product from its **production** and **consumption** point of view
- The **reduction in consumption**, and **utilization of discarded products within the production** system as a substitute for new resources, can lead to reduced end-of-cycle waste generation
- **less efforts and resources** would be required for the final disposal of the waste.



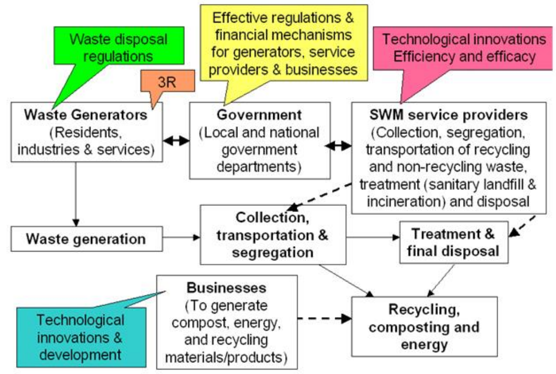
Generation-based Integrated Solid Waste Management

- based on its **generation from different sources** including domestic, commercial, industrial and agriculture.
- This waste could be further classified as **hazardous and non-hazardous waste.**
- The former has to be **segregated at source** and treated for disposal in accordance with the **strict regulations**.
- **3R approach (reduce, reuse and recycle)** is applicable both at source as well as at the different levels of solid waste management chain including collection, transportation, treatment and disposal

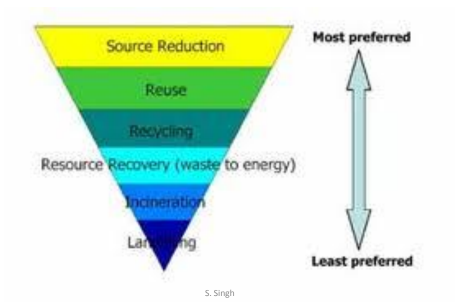


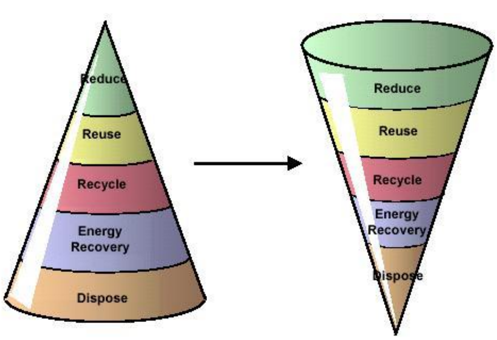
Management-based Integrated Solid Waste Management

- based on its **management** which includes regulations and laws, institutions, financial mechanisms, technology and infrastructure, and role of various stakeholders in the solid waste management chain



Resource recovery in solid waste management





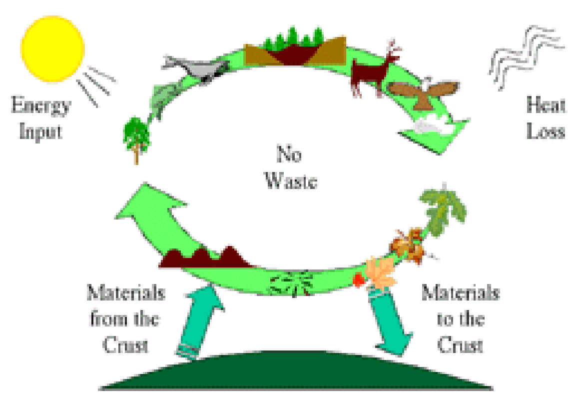


Figure 1. Nature's cycles.

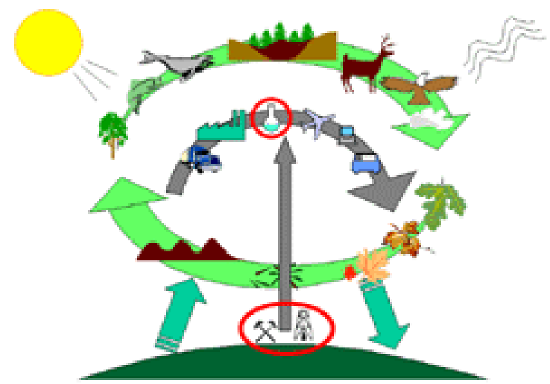


Figure 2. Today's Cycles of Nature and Society

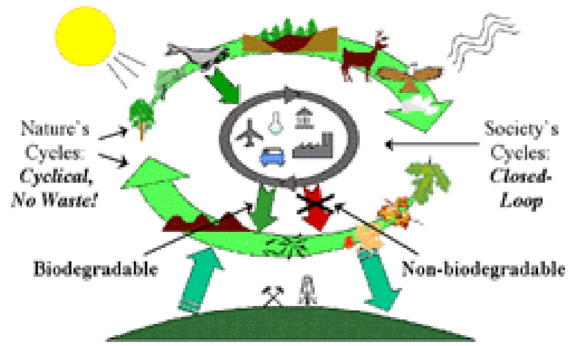


Figure 3. Ideal Cycles of Nature and Society

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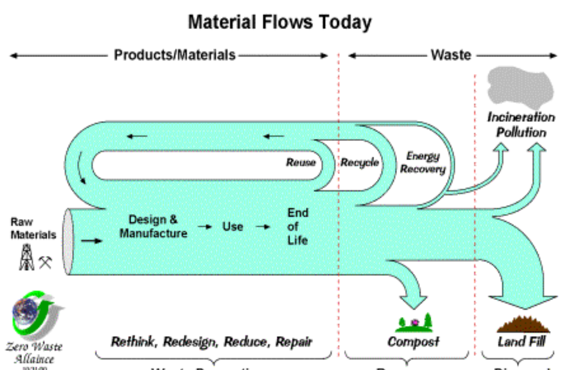

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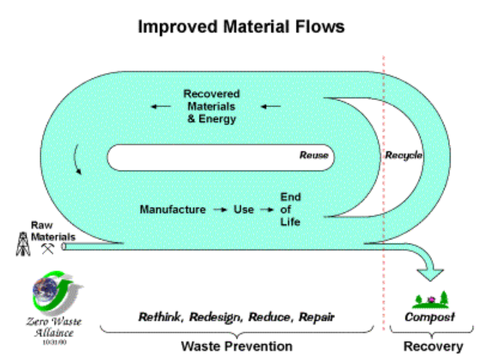

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Elements of Eco city

The declaration from the Eco city World summit in San Francisco defines the necessary elements of an Eco city as follows:

- Ecological security
- Ecological sanitation
- Ecoscape integrity
- Ecological industrial metabolism
- Ecological awareness

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elements

Ecological security

- Clean air
- Safe, reliable water supplies
- Food security
- Healthy housing and workplaces
- Municipal services and protection against disasters for all people.

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elements

Ecological sanitation

- efficient, cost-effective eco-engineering for treating and recycling human excreta, gray water, and all wastes.

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elements

Ecological industrial metabolism

- resource conservation and environmental protection through industrial transition
- emphasizing **materials re-use**, **life-cycle production**, **renewable energy, efficient transportation**, and meeting human needs.

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elements

Ecoscape (ecological-landscape) integrity

- arrange built structures, open spaces, infrastructure, and natural features to **maximize biodiversity.**
- **maximize accessibility** of the city for all citizens while **conserving energy and resources** and alleviating such problems as automobile accidents, air pollution, hydrological deterioration, heat island effects and global warming.

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elements

Ecological awareness

- help people **understand their place in nature,** cultural identity, responsibility for the environment, and help them change their **consumption behavior** and **enhance their ability** to contribute to maintaining **high quality urban ecosystems.**

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PRACTICES/MODELS OF ECOCITY IN THE GLOBAL CONTEXT

The United Nations *Earth Summit* (Rio de Janeiro, 1992), and the resulting sustainable development programme (*Agenda 21*), formed the background to a first wave of practical eco-city initiatives.

- first-generation eco-cities:
  - Curitiba (Brazil),
  - Waitakere (New Zealand)
  - Schwabach(Germany)

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PRACTICES/MODELS OF ECOCITY IN THE GLOBAL CONTEXT

- In 2009, the International Eco-Cities Initiative published its first global survey, covering some **79 initiatives**
- UPDATED IN 2011 as **178 initiatives**

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PRACTICES/MODELS OF ECOCITY IN THE GLOBAL CONTEXT

Type of eco-city development
- I—new development
- II—expansion of urban area
- III—retro-fit development

Development phase
- 1—pilot/planning stage
- 2—under construction
- 3—implemented

Key implementation mode
- a—technological innovation
- b—integrated sustainability vision/planning
- c—civic empowerment/involvement

Type of Eco-City Development by Continent

(Joss, Tomozeiu, & Cowley, 2011)

	Asia & Australasia	Europe	Middle East & Africa	Americas	Total
I - New development:	15	2	4	6	27
II - urban expansion	17	45	4	6	72
III - retro-fit:	37	23	2	13	75
total	69	70	10	25	174

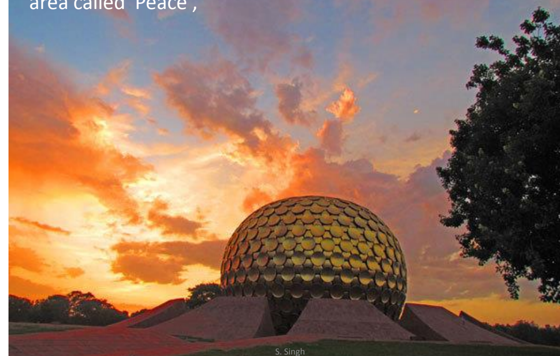
Nov 2011:
175 Amanora Park Town (Pune, India)
176 Copenhagen Eco-Metropolis 2015 (Denmark)
177 Eco Island (Isle of White, United Kingdom)
178 One Planet Middlesbrough (United Kingdom)

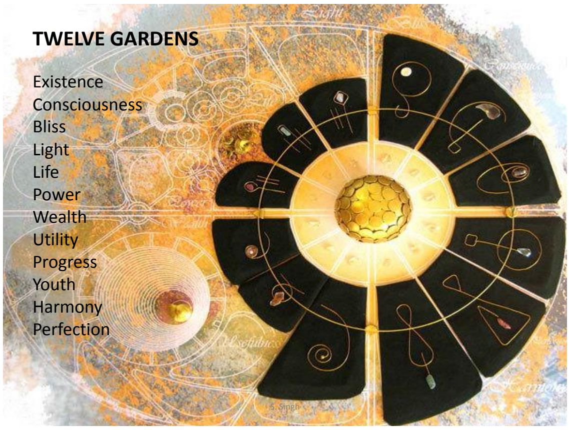
Eco Village: Auroville

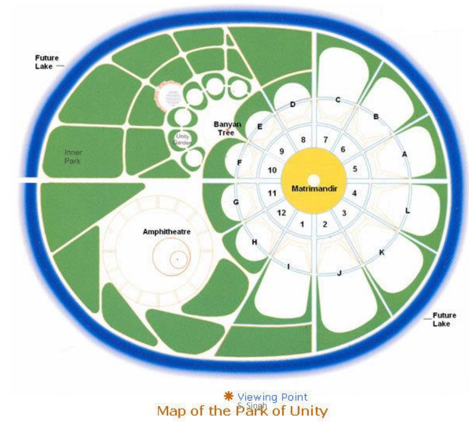
- Auroville is located 160 km south of Chennai on the east coast of India, just 6 km north of Pondicherry.

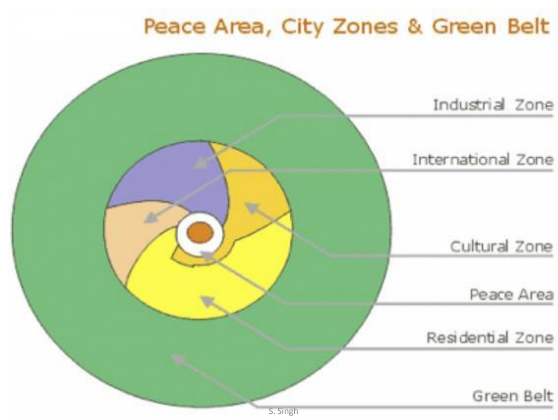
- Township for 50,000 inhabitants with a circular form, covering an area of about 20 sq. km.
- Initially the site was a barren plateau traversed by dry canyons and gullied land with hardly any vegetation

'soul of the city', the Matrimandir, situated in a large open area called 'Peace',









Residential zone

- 189-hectare
- residential community buildings, community meeting spaces, crèches and lower age group educational needs, work studios, first aid centres, parks, playgrounds, landscaping elements, eco-friendly parking areas, kiosks and convenience stores, with the additional possibility of small handicraft ateliers.
- dwellings and city level retail stores, display areas, communication and recreation centres, restaurants, libraries and reading rooms, health centres, essential utility needs, city management sub-offices for services such as fire, water, sanitation and post/telecom, parks & green areas and eco-friendly parking.
- guesthouses, department stores, some small professional offices, utility maintenance centres and essential transport related infrastructure and conference facilities.

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Cultural zone

- The 103-hectare
- various cultural institutions and research centres related to education, arts and sport
- City level cultural uses such as auditoriums and exhibition halls, parks and playgrounds, green areas, kiosks and convenience stores, a stadium and large spaces with sports facilities.

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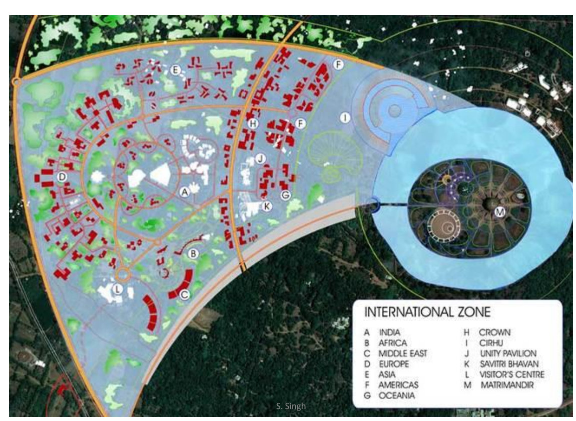

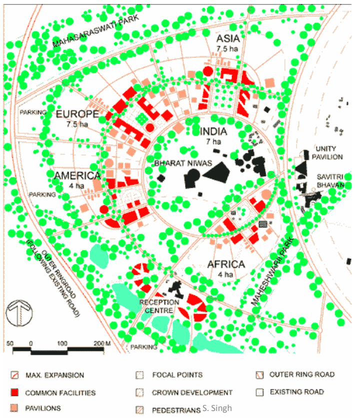

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Green belt zone

Categories of use:
- agriculture and farming
- forest and land regeneration
- recreation.

- to promote biodiversity enhancement
- environmental management
- land regeneration
- water management

National Resource Centre (NRC) for sustainable development.

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- From a barren and marginal land in 1968, today it has become a developed and productive land, entirely through the efforts of Aurovilians.
- Out of 20 sq. km of the designated area of the township, about 12% is presently developed for urban uses and the rest is under agriculture, plantation and other non-urban uses.
- Resident Aurovilians (around 2000 in 2001)
- Researchers and students, who come for short duration to learn and contribute to the efforts of development.
- Day-workers from neighbouring villages working in Auroville's economic and service activities.
- Short-term, including casual visitors coming to see the experience of Auroville's work in diverse fields.

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Key initiatives

- Waste Land Regeneration,
- Watershed Management
- Reforestation projects.

All this contributed in regenerating the barren land into a productive and developable site for urban and green uses.

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Key initiatives

Regenerated areas

- The **trees planted** have modified the stark landscape
- plantations not only have improved the environment but have **also restored the land for productive agriculture** by **preventing soil erosion**. Plantations include both indigenous as well as exotic species.

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Key initiatives

Agriculture and Related uses

- include land either for **food production** (including vegetables and fruits) needed by residents, or **for research in improving farm practices and diversifying cropping patterns.**
- The Auro-Orchard and Pitchandikulam medicinal herbal stations are some typical examples.
- In most of the cases both production and research are carried out together. Most of these are based on **organic farming practices.**

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Key initiatives

Farming

includes lands generally used by the villagers for growing paddy, casuarina or other crops including cashew.

Water bodies :

There are five 'eris' in the area of which two are large in size, namely the Irumbai eri and the Alankuppam eri.

These are **seasonal water bodies** which help irrigate small extents of land particularly after the rainy season.

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Key initiatives

- Since Auroville is experimenting with **appropriate construction elements,** wall materials vary widely from **adobe, stabilised earth blocks and rammed earth to fired bricks.**
- Auroville has even experimented with the **'fire bricks house'** technique, where the entire structure is built in earth and fired like a kiln, producing a innovatively constructed house.

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Key initiatives

- The architecture here reflects the **practice of innovative design and alternative building materials.**
- The experiments made in building technology in Auroville will have far-reaching implications in terms of design and materials, of reduction in energy consumption, and adoption of **eco-friendly practices.**

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Key initiatives

- The **surface of the internal access** as well as **circular road** has intentionally been kept as **gravel to allow percolation of rainwater** for **re-charging the aquifers**.
- Conceptually these are maintained as **pedestrian roads**, but slow moving traffic consisting of cycles and scooters is slowly and steadily increasing.

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Key initiatives

- **rainwater runoff from roads and paved areas** is diverted to the **canyons, where a system of check dams helps in storage and recharge of ground water.**

- All residential units have their **own system for sewage disposal**. consisting of septic tanks, Imhoff tanks, baffle reactors, and root zone and lagooning systems.
- There are about **20 community-level treatment facilities** (for residential as well as industrial and commercial units)

Key initiatives

- **Solid waste disposal** is managed by the Eco Service, which was started in 1995.
- It is estimated that about 3500 kg of wastes are generated per week. About 2000 kg. of this quantity is organic and generally composted at the site itself.
- About 1000 kg. is recycled and the balance of 500 kg is incinerated in the Health Centre at 800 °C.

Key initiatives

- The non-recyclable wastes of 400 to 500 kg, like rubber items, thermocole, fibreglass and PET, and storage batteries are stored in a temporary storage facility until an acceptable disposal solution is found.
- This waste disposal management has been made possible by the introduction of segregation of wastes at the source.

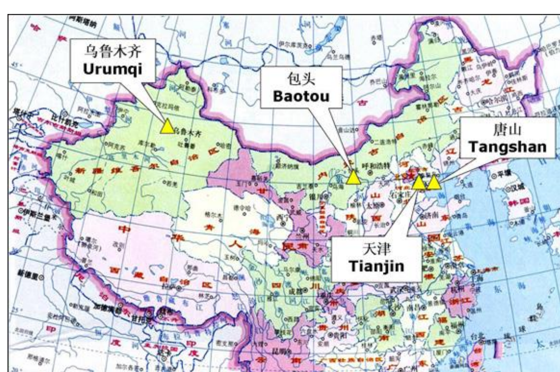
Key initiatives

- About 150 houses **use solar PV electricity** and heaters for their energy requirements.

- In addition, there are about **140 solar water-pumping systems and 30 wind-driven pumps.**

Key initiatives

- Socio cultural development
  - Spiritual centre
  - Socio cultural facilities
  - Village outreach programs
  - Educational programs
  - Health centres
  - Community participation etc



Sino Singapore Tianjin eco city (China)

Sino Singapore Tianjin eco city (China)

- Like many Chinese "eco-cities", it is located in an extremely industrial and polluted area and meant to act as a catalyst for change
- 40 km from Tianjin city centre and 150 km from Beijing city centre. It is located within the Tianjin Binhai New Area – one of the fastest growing regions in China.
- Total land area of 30 sq. km. population of 350,000.

Sino Singapore Tianjin eco city (China)

Sino Singapore Tianjin eco city (China)

Prior to the development of the Eco-city, the site comprised mainly saltpans, barren land and polluted water-bodies, including a 2.6 sq km large wastewater pond.

For centuries, the land has been used as salt farms. The north and the south, built-up by chemical industries, of the city belong among the most polluted areas in the region.

The goal was to develop the Eco-city over 10-15 years.

Sino Singapore Tianjin eco city (China)

The Tianjin Eco-city's vision is to be *"A thriving city which is socially harmonious, environmentally-friendly and resource-efficient – a model for sustainable development".*

"Three Harmonies"

- People living in harmony with other people, i.e. social harmony
- People living in harmony with economic activities, i.e. economic vibrancy
- People living in harmony with the environment, i.e. environmental sustainability

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Sino Singapore Tianjin eco city (China)

"Three Abilities"

- Practicable - the technologies adopted in the Eco-city must be affordable and commercially viable
- Replicable - the principles and models of the Eco-city could be applied to other cities in China and even in other countries
- Scalable - the principles and models could be adapted for another project or development of a different scale

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KEY FEATURES

- environmental protection
- resource conservation
- recycling economy
- ecological infrastructure development
- use of renewable energy
- reuse of wastewater
- sustainable development
- promotion of social harmony

key features

While initially the district will derive energy from a waste incinerator plant, several other options for energy generation are under consideration, including clean fuel, renewable (solar) and geothermal energy.

All buildings will conform to stringent energy efficiency standards.

The district is planned to allow for up to 90% public transport, cycling and walking.

Advanced water saving and waste management systems will be implemented.

The existing wetlands around the city will be protected to enhance biodiversity.

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Eco city elements

Land-use Planning

- Compact, with a good mix of land uses based on Transit-Oriented Development (TOD) principles.
- Each district is planned with amenities and jobs located close by.
- Local and centralised facilities are provided to serve the needs of residents in each neighbourhood.
- Each district is served by urban centres.
- Business Parks are located close to residential areas to provide employment for residents, which is within easy access of their homes.

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Green and Blue Network Planning

extensive green (vegetation) and blue (water) networks in mind to provide an endearing living and working environment.

The green network: a green lung at the core of the Eco-city and green-relief eco-corridors emanating from the lung to the other parts of the Eco-city.

Water bodies in the Eco-city will be linked together for greater water circulation to enhance the ecology and to provide an attractive environment for waterfront development and water-based recreational activities.

A wastewater pond is rehabilitated and transformed into a clean and beautiful lake.

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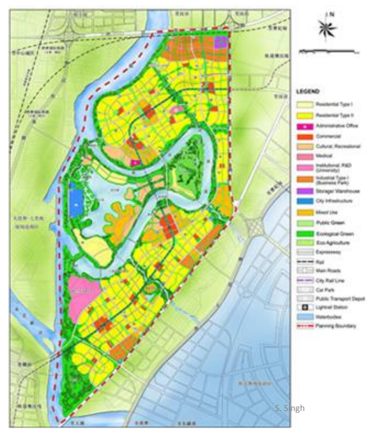

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"1 Axis – 3 Centres – 4 Districts"

"1 Axis"

- Eco valley: the green spine of the city linking up the City Centre, the 2 sub-centres and the 4 districts in the Eco-city
- a scenic trail for pedestrians and cyclists.
- The tram system, which will be built to meet the Eco-city's transport needs, will run along the Eco-valley

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"3 Centres"

- the main City Centre on the promontory on the south bank of the Old Ji Canal
- and the two sub-centres in the south and the north.

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"4 Districts“

- the residential districts in the southern, central, northern and north-eastern parts of the Eco-city.
- Each district contains several housing neighbourhoods comprising a variety of housing types
- as well as their respective commercial and amenity centres serving their communities.

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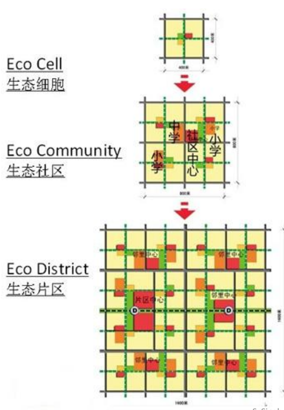

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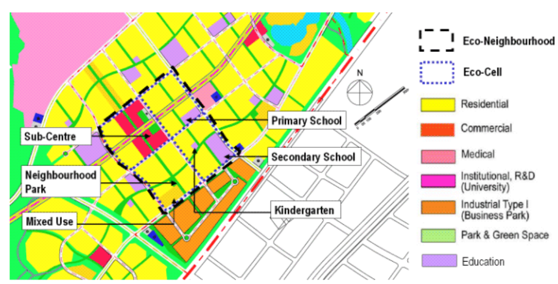
The Eco-cell basic building blocks. Each cell is about 400m by 400m (comfortable walking distance.)

Four Eco-cells make an Eco-neighbourhood.

Several Eco-Neighbourhoods form an Eco-district.

There are 4 Eco-districts



An illustration of the Eco-cell

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Eco city elements

Transportation planning

- The emphasis on green
- The aim is to increase trips via public transport and non-motorised modes of transport such as via bicycles and walking within the Eco-city.
- non-motorised and motorised networks are separated to minimize conflict between pedestrians, cyclists and vehicles, with priority given to pedestrians and non-motorized transport, as well as public transport.

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KEY PERFORMANCE INDICATORS (KPI)

The KPIs were jointly formulated by experts from Singapore and China and endorsed by the Ministerial-level Eco-city Joint Working Committee.

- Qualitative KPI
- Quantitative KPI

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Key performance indicators (KPI)

Qualitative KPIs

- Maintain a safe and healthy ecology through green consumption and low-carbon operations.
- Adopt innovative policies that will promote regional collaboration and improve the environment of the surrounding regions.
- Give prominence to the river estuarine culture to preserve history and cultural heritage, and manifest its uniqueness.
- Complement the development of recycling industries and promote the orderly development of the surrounding regions.

QUANTITATIVE (KPI)

Good Natural Environment

- Ambient Air Quality
- Quality of water bodies within the Eco-city
- Quality of Water from Taps
- Noise Pollution Levels
- Carbon Emission Per Unit GDP
- Net Loss of Natural Wetlands

Healthy Balance in the Man–made Environment

- Proportion of Green Buildings
- Native Vegetation Index
- Per Capita Public Green Space

Good Lifestyle Habits

- Per Capita Daily Water Consumption
- Per Capita Daily Domestic Waste Generation
- Proportion of Green Trips
- Overall Recycling Rate
- Access to Free Recreational and Sports Amenities
- Waste Treatment
- Barrier-Free Accessibility
- Services Network Coverage
- Proportion of Affordable Public Housing

Developing a Dynamic and Efficient Economy

- Usage of Renewable Energy
- Usage of Water from Non-Traditional Sources
- Proportion of R&D Scientists and Engineers in the Eco-city Workforce
- Employment-Housing Equilibrium Index

S. Singh

Good Natural Environment

- Ambient Air Quality
- Quality of water bodies within the Eco-city
- Quality of Water from Taps
- Noise Pollution Levels
- Carbon Emission Per Unit GDP
- Net Loss of Natural Wetlands

Healthy Balance in the Man–made Environment

- Proportion of Green Buildings
- Native Vegetation Index
- Per Capita Public Green Space

Good Lifestyle Habits

- Per Capita Daily Water Consumption
- Per Capita Daily Domestic Waste Generation
- Proportion of Green Trips
- Overall Recycling Rate
- Access to Free Recreational and Sports Amenities
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KITAKYUSHU ECO CITY, JAPAN

Population (2014):

963,259

Area: 485 sq.km

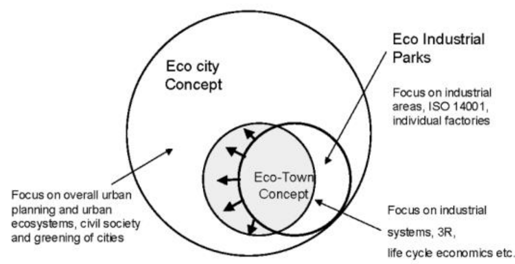
KITAKYUSHU ECO CITY, JAPAN

- industrialization the World War II with rapid economic growth in the 1950s and 1960s leading to environmental problems
- Shortage of dumping sites for waste disposal
- 1997 ECO TOWN concept introduced
- Eco city development initiative 2009
- Apart from the Eco town and Eco city development initiatives, the Japanese government has also launched an environment-friendly "Future City" Initiative (FCI) in 2011.

Future cities initiatives

- Its goal is to solve problems being faced by Japan and the world such as
- global warming,
- resource and energy constraints,
- and aging societies

through establishing sustainable social and economic systems and recovering social solidarity.



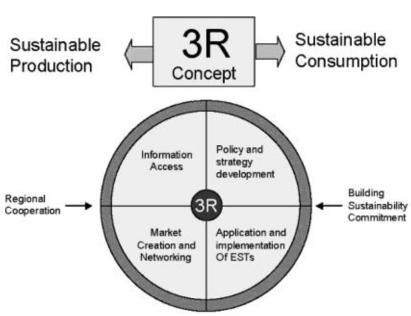
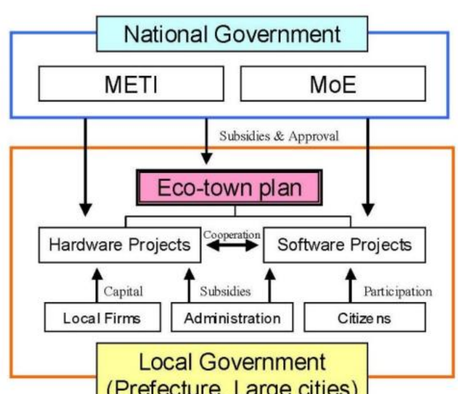
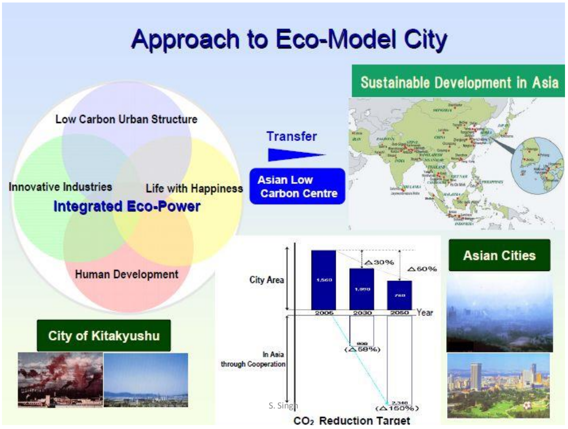


Fig.1-1. 3R Concept

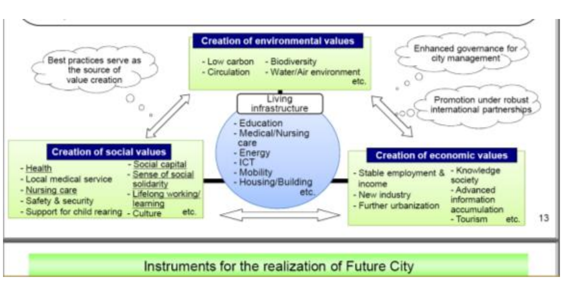


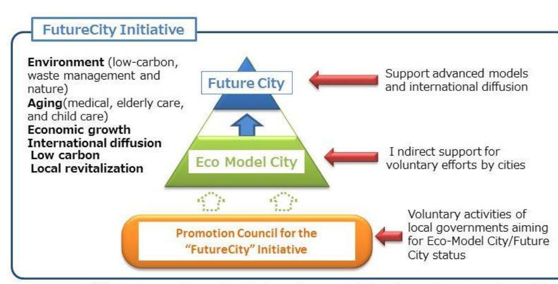


KITAKYUSHU ECO CITY, JAPAN

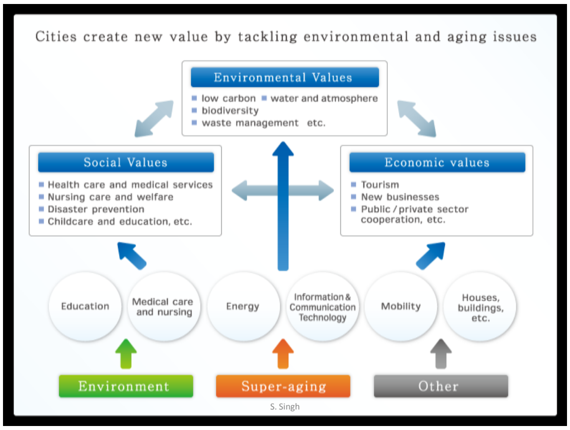
- Redevelopment to a compact city (walkable communities)
- Improvement of transportation infrastructure (public transportation such as LRTs, and EVs)
- Change in residential styles (houses built to last 200 years, energy saving houses, fuel cells)
- Widespread use of renewable energy (solar power, wind power, biomass etc.)
- Conservation and utilization of forests (carbon offset, local production for local consumption)

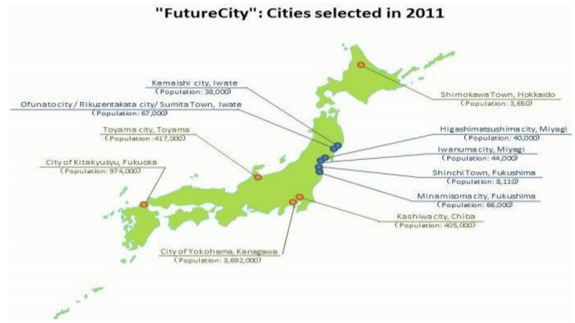
FUTURE CITIES INITIATIVE

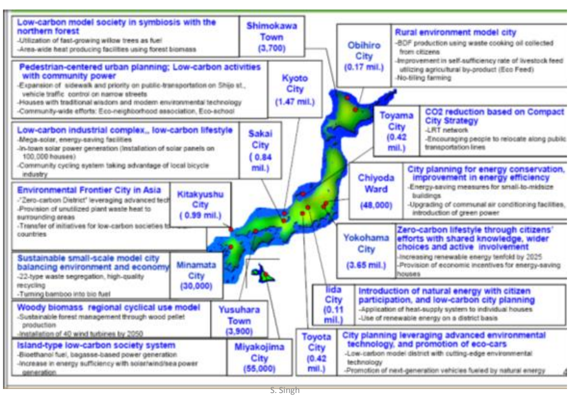




※None council member is also able to apply for the environmental model city


Cities create new value by tackling environmental and aging issues
Environmental Values
low carbon
water and atmosphere
biodiversity
waste management etc.
Social Values
Health care and medical services
Nursing care and welfare
Disaster prevention
Childcare and education, etc.
Economic values
Tourism
New businesses
Public / private sector cooperation, etc.
Education
Medical care and nursing
Energy
Information & Communication Technology
Mobility
Houses, buildings, etc.
Environment
Super-aging
Other
S. Singh


"FutureCity": Cities selected in 2011
Kamaishi city, Iwate (Population: 38,000)
Ofunato city / Rikuzentakata city / Sumita Town, Iwate (Population: 67,000)
Toyama city, Toyama (Population: 417,000)
City of Kitakyusyu, Fukuoka (Population: 974,000)
City of Yokohama, Kanagawa (Population: 3,692,000)
Shimokawa Town, Hokkaido (Population: 3,650)
Higashimatsushima city, Miyagi (Population: 40,000)
Iwanuma city, Miyagi (Population: 44,000)
Shinchi Town, Fukushima (Population: 8,110)
Minamisoma city, Fukushima (Population: 66,000)
Kashiwa city, Chiba (Population: 405,000)
S. Singh


Low-carbon model society in symbiosis with the northern forest
Shimokawa Town (3,700)
Pedestrian-centered urban planning; Low-carbon activities with community power
Kyoto City (1.47 mil.)
Low-carbon industrial complex., low-carbon lifestyle
Sakai City (0.84 mil.)
Environmental Frontier City in Asia
Kitakyushu City (0.99 mil.)
Sustainable small-scale model city balancing environment and economy
Minamata City (30,000)
Woody biomass regional cyclical use model
Yusuhara Town (3,900)
Island-type low-carbon society system
Miyakojima City (55,000)
Obihiro City (0.17 mil.)
Rural environment model city
Toyama City (0.42 mil.)
CO2 reduction based on Compact City Strategy
Chiyoda Ward (48,000)
City planning for energy conservation, improvement in energy efficiency
Yokohama City (3.65 mil.)
Zero-carbon lifestyle through citizens' efforts with shared knowledge, wider choices and active involvement
Iida City (0.11 mil.)
Introduction of natural energy with citizen participation, and low-carbon city planning
Toyota City (0.42 mil.)
City planning leveraging advanced environmental technology, and promotion of eco-cars
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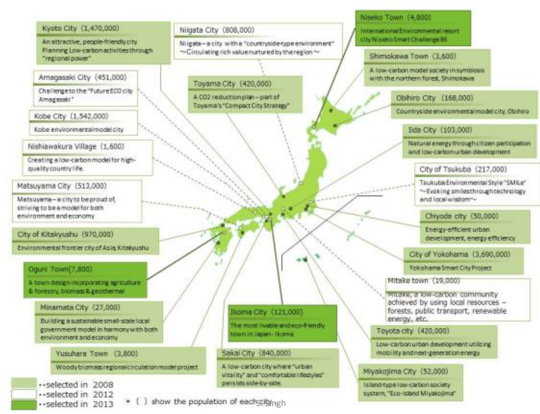
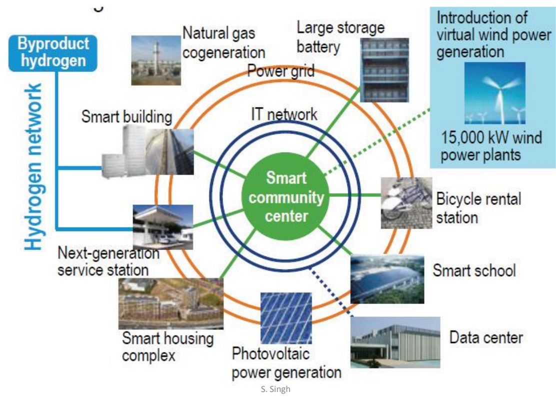

Kyoto City (1,470,000)
Niigata City (808,000)
Niseko Town (4,800)
Amagasaki City (451,000)
Toyama City (420,000)
Shimokawa Town (3,600)
Kobe City (1,542,000)
Obihiro City (168,000)
Nishiawakura Village (1,600)
Iida City (103,000)
City of Tsukuba (217,000)
Matsuyama City (513,000)
Chiyoda city (50,000)
City of Kitakyushu (970,000)
City of Yokohama (3,690,000)
Oguni Town (7,800)
Mitaka town (19,000)
Minamata City (27,000)
Ikoma City (121,000)
Toyota city (420,000)
Yusuhara Town (3,800)
Sakai City (840,000)
Miyakojima City (52,000)
··selected in 2008
··selected in 2012
··selected in 2013
( ) show the population of each city
S. Singh


Human resources
Goods
Concentrate
Capital
Regulatory reforms
etc...
International network
Hands-on projects to create new value
FutureCity
cities where "everybody wants to live" and "everyone has vitality"
Technology
Socioeconomic system
Service
Business models
City planning
etc...
Improve Quality of Life
Disseminate
Best Practices
(domestic and overseas)
Virtuous circle of financially autonomous models
S. Singh


Eco-City showcase set up a new energy of solar power generation, etc. in the city center area near the MURASAKIGAWA-River
Wind power
Solar power
Electric Vehicle
LED
rooftop greening
S. Singh



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Curitiba, Brazil

- Curitiba, Brazil, is recognized as **a model of urban planning**. The city's innovative practices have been internationally praised for the past twenty years.
- Sustainable initiatives were implemented in Curitiba before sustainability became the preferred alternative for development.
- Considered as **''a world-recognized model of environmental and planning practices,''** and ''the **ecological capital** of the world in the **world urban forum held in 1992 in Curitiba**

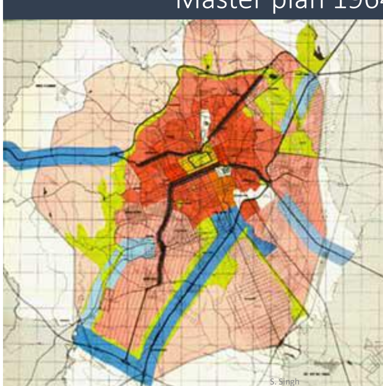
S. Singh

Case study: Curitiba, Brazil

- political continuity and consistent planning made it possible for Curitiba to implement the projects that gave the city the international recognition
- Technocrats turned politicians treated Curitiba as a laboratory, and those initiatives that were successful created a city that became a symbol of sustainable planning.
- Jamie Lerner, urban planner and Mayor/ Governor of Curitiba

S. Singh

Master plan 1964



Integration of landuse with street network and public transit routes

Agache's radial road system into linear axes, radiating from downtown

Growth along transit oriented corridors (high density and mixed lanuse

S. Singh

Sustainable initiatives

- The **planning Institute IPPUC** established for the implementation of the master plan was a breeding ground and synergy hub for the minds that devised the creative initiatives
- Several mayors were IPPUC directors before running for elected office: tied planning to politics
- Ivo Arzua Pereira and Jaime Lerner both from technical background (engineers)
- CIC—Cidade Industrial de Curitiba (Industrial City of Curitiba) was established and became the trademark of Jaime Lerner's first term in office and was part of a new development policy to spur industrial development in the state of Parana´

S. Singh

Efficient urban mobility (BRT)

- The urbanization company—URBS—was created to manage and implement infrastructure and transportation projects which is responsible for the renowned transit system of Curitiba.
- Curitiba has a transit system comprising exclusively busses, with some routes running on dedicated lanes. The ‘‘tube stations,’’ created especially for the Ligeirinho route proved to be such an improvement that they were eventually implemented along all corridors that structure Curitiba’s transit system
- The transformation of the city’s busiest street into a pedestrian mall over a single weekend is one of these well-known projects undertaken by Jamie Lerner

S. Singh

civic downtown and social spaces

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S. Singh

Sustainable solid waste management

- **The “green exchange” employment program**
  - focuses on social inclusion, benefiting both those in need and the environment.
  - **Low-income families living in shantytowns** unreachable by truck **bring their trash bags to neighborhood centers**, where they **exchange them for bus tickets and food.**
  - There’s also a program for children where they can **exchange recyclable garbage for school supplies, chocolate, toys and tickets for shows.**

S. Singh

Sustainable solid waste management

- **“garbage that’s not garbage” program**
  - 70% of the city’s trash is recycled by its residents.
  - Once a week, a truck collects paper, cardboard, metal, plastic and glass that has been sorted in the city’s homes.
  - The city’s paper recycling alone saves the equivalent of 1,200 trees a day.
  - money raised from selling materials goes into social programs, and the city employs the homeless and recovering alcoholics in its garbage separation plant.” (ICLEI-Canada)

S. Singh

Green landscape and water bodies

- **Several parks** were also implemented during Lerner’s third administration; these were part of a strategy he later called **“urban acupuncture”.**
- **Green zoning safeguards open spaces** and **stiff regulations protect every tree in the city.**
- Nearly one-fifth of the city is parkland, and volunteers have planted 1.5 million trees along the streets.” (ICLEI)
- Parks have been created from abandoned dumps and quarries. The numerous **“ethnic” groups (theme partks):** a wooden Ukrainian church, a **sombre Bavarian forest** where a witch tells her tales, a Japanese haven of peace in the midst of skyscrapers, a path for strolling Italians….

S. Singh

Green landscape and water bodies

- In 1970, there was less than 1 square meter of green space per person; now there are **52 square meters for each person.**
- Builders get tax breaks if their projects include green space.
- The **artificial lakes are created to prevent flooding**. **Flood waters diverted into new lakes in parks solved the problem of dangerous flooding,** while also protecting valley floors and riverbanks, acting as a barrier to illegal occupation, and providing aesthetic and recreational value to the thousands of people who use city parks" (ICLEI)
- Acquired land around river to create three lakes that can overflow into park space, rather than fortify the river with concrete walls.

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Housing

- **Curitiba's housing authority—Cohab-CT—was also created** during Arzua's administration and **several affordable housing complexes** were built, including some to accommodate families relocated from informal settlements.
- Innovations in housing were also salient.

  A program called **Solo Criado** was implemented; based on **transfer of development rights**, this program allows developers to **build additional square footage** in certain locations in **exchange for the preservation of other lands or historic properties.**
- In addition, developers are able to **purchase development bonuses**; the **proceeds are deposited into the Municipal Housing Fund**, **which is then used to implement affordable housing projects.**

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Industrial ecology

- In Curitiba industry is organised around the idea of 'industrial ecology' the planning of industries so that their activities complement each other
- sharing heat or transport
- forming a flow of materials, the waste of one industry being the raw material for another

S. Singh

others

- downtown revitalization
- infrastructure for arterial roads, drainage infrastructure including the channelization of downtown rivers

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Transportation Planning

- Transportation planning is the process of defining future policies, goals, investments and designs to prepare for future needs to move people and goods to destinations.
- As practiced today, it is a collaborative process that incorporates the input of many stakeholders including various government agencies, the public and private businesses.

Transportation Planning

- Transportation planning is also commonly referred to as transport planning internationally, and is involved with the evaluation, assessment, design and siting of transport facilities (generally streets, highways, bike lane public transport lines).

Transportation Planning

- Transportation planning, or transport planning, has historically followed the rational planning model of defining goals and objectives, identifying problems, generating alternatives, evaluating alternatives, and developing plans. Other models for planning include rational actor, transit oriented development, incremental planning, organizational process, and political bargenning.

- Planners are increasingly expected to adopt a multi-disciplinary approach, especially due to the rising importance of environmentalism. For example, the use of behavioural psychology to persuade drivers to abandon their automobiles and use public transport instead.

Transport Planning

- The role of the transport planner is shifting from technical analysis to promoting sustainability through integrated transport policies.
- For example, in Hanoi the increasing number of motorcycles is responsible not only for environmental damage but also for slowing down economic growth.
- In the long run the plan is to reduce traffic through a change in urban planning. Through economic incentives and attractive alternatives experts hope to lighten traffic in the short run.

- Transportation
- Land Use
- Services

Energy Efficient City Planning

- Compact Settlement
- Mix use Planning
- Zoning
- Transportation
- Sharing infrastructure and services

Eco-City

- Ecologically sound and sustainable
- Independent-self sustain
- Organized
- Future genaration

Sustainable Development

- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

Sustainable Development

- Sustainable development (SD) is a socio-ecological process characterized by the pursuit of a common ideal.
- Sustainable development is the organizing principle for sustaining finite resources necessary to provide for the needs of future generations of life on the planet.

Sustainable Development

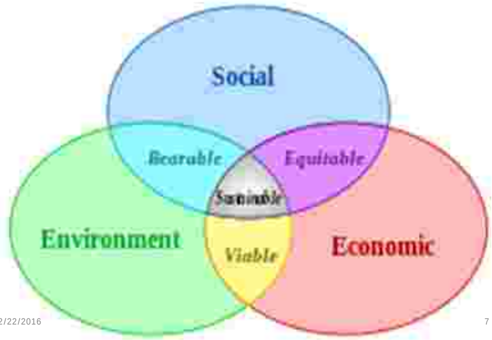
- It is a process that envisions a desirable future state for human societies in which living conditions and resource-use continue to meet human needs without undermining the "integrity, stability and beauty" of natural biotic system.

- Sustainability can be defined as the practice of reserving resources for future generation without any harm to the nature and other components of it .
- Sustainable development ties together concern for the carrying capacity of natural system with the social, political, and economic challenges faced by humanity.
- Sustainability science is the study of the concepts of sustainable development and environmental science. There is an additional focus on the present generations' responsibility to regenerate, maintain and improve planetary resources for use by future generations.

- It can also be defined as any construction that can be maintained over a long period of time without damaging the environment and the development balancing near-term interests with the protection of the interests of future generations.

- Sustainable development has been described in terms of three dimensions, domains
- In the three-dimension model, these are seen as "economic, environmental and social" or "ecology,
- economy and equity" this has been expanded by some authors to include a fourth pillar of culture
- institutions or governance

Scheme of sustainable development:
at the confluence of three constituent parts.



Ecology

- Relationship between ecological footprint and Human Development index(HDI)
- The ecological sustainability of human settlements is part of the relationship between humans and their natural, social and built environments.

- It also termed human ecology, this broadens the focus of sustainable development to include the domain of human health.
- Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development; addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species.

Environment

Environmental sustainability concerns the natural environment and how it endures and remains diverse and productive. Since natural resources are derived from the environment, the state of air, water, and the climate are of particular concern.

- Sustainability is knowledge about scientific, technical and socio-economic information concerning climate change, and lists options for adaptation andmitigation.
- Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet.
- This, for example, entails using water sustainably, utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).

Agriculture

- Sustainable agriculture consists of environmentally friendly methods of farming that allow the production of crops or livestock without damage to human or natural systems.
- It involves preventing adverse effects to soil, water, biodiversity, surrounding or downstream resources—as well as to those working or living on the farm or in neighboring areas.

- The concept of sustainable agriculture extends inter-generationally, passing on a conserved or improved natural resource, biotic, and economic base rather than one which has been depleted or polluted.
- Elements of sustainable agriculture include permaculture, agroforestry, mixed farming, multiple cropping, and crop rotation.

Energy

- Sustainable energy is clean and can be used over a long period of time. Unlike fossil fuels that most countries are using, renewable energy only produces little or even no pollution. The most common types of renewable energy in US are hydroelectric, solar and wind energy; solar energy are commonly used on public parking meter, street lights and the roof of buildings.

- Wind Power has expanded quickly, it's share of worldwide electricity usage at the end of 2014 was 3.1%. Most of California's fossil fuel infrastructures are sited in or near low-income communities, and have traditionally suffered the most from California's fossil fuel energy system.

- These communities are historically left out during the decision-making process, and often end up with dirty power plants and other dirty energy projects that poison the air and harm the area. These toxicants are major contributors to health problems in the communities. As renewable energy becomes more common, fossil fuel infrastructures are replaced by renewables, providing better social equity to these communities.[25] Overall, and in the long run, sustainable development in the field of energy is also deemed to contribute to economic sustainability and national security of communities, thus being increasingly encouraged through investment policies.[26]

Transportation

- Transportation is a large contributor to greenhouse gas emissions. It is said that one-third of all gasses produced are due to transportation.
- Some western countries are making transportation more sustainable in both long-term and short-term implementations.

- An example is the modifications in available transportation in Freiburg, Germany. The city has implemented extensive methods of public transportation, cycling, and walking, along with large areas where cars are not allowed.
- Since many western countries are highly automobile-orientated areas, the main transit that people use is personal vehicles. About 80% of their travel involves cars. Therefore, California, deep in the automobile-oriented west, is one of the highest green house gases emitters in the country.

- The federal government has to come up with some plans to reduce the total number of vehicle trips in order to lower greenhouse gases emission.

Such as:

- Improve public transit through the provision of larger coverage area in order to provide more mobility and accessibility, new technology to provide a more reliable and responsive public transportation network.

- Encourage walking and biking through the provision of wider pedestrian pathway, bike share station in commercial downtown, locate parking lot far from the shopping center, limit on street parking, slower traffic lane in downtown area.
- Increase the cost of car ownership and gas taxes through increased parking fees and tolls, encouraging people to drive more fuel efficient vehicles.

- They can produce social equity problem, since lower people usually drive older vehicles with lower fuel efficiency. Government can use the extra revenue collected from taxes and tolls to improve the public transportation and benefit the poor community.
- Other states and nations have built efforts to translate knowledge in economics into evidence based sustainable transportation policies.

Economics

- It has been suggested that because of rural poverty and over exploitation, environmental resources should be treated as important economic assets, called natural capital.
- Economic development has traditionally required a growth in the gross domestic product This model of unlimited personal and GDP growth may be over.
- Sustainable development may involve improvements in the quality of life for many but may necessitate a decrease in resource consumption.

- According to ecological economist Malte Faber ecological economics is defined by its focus on nature, justice, and time.
- Issues of intergenerational, equity, irreversibility of environmental change, uncertainty of long-term outcomes, and sustainable development guide ecological economic analysis and valuation.

- As early as the 1970s, the concept of sustainability was used to describe an "economy "in equilibrium with basic ecological support systems.
- Scientists in many fields have highlighted The limits to growth and economists have presented alternatives, for example a 'steady state economy'.

- to address concerns over the impacts of expanding human development on the planet. In 1987 the economist Edward Barbier published the study *The Concept of Sustainable Economic Development*, where he recognized that goals of environmental conservation and economic development are not conflicting and can be reinforcing each other.

- A study from 2001 noted that efficient policies for renewable energy and pollution are compatible with increasing human welfare, eventually reaching a golden-rule steady state.
- The study, *Interpreting Sustainability in Economic Terms*, found three pillars of sustainable development, interlinkage, intergeneral equity, and dynamic efficiency.

- A meta review in 2002 looked at environmental and economic valuations and found a lack of "sustainability policies"[1] A study in 2004 asked if we consume too much.
- A study concluded in 2007 that knowledge, manufactured and human capital(health and education) has not compensated for the degradation of natural capital in many parts of the world.[1]

- It has been suggested that intergenerational equity can be incorporated into a sustainable development and decision making, as has become common in economic valuations of climate economics.
- A meta review in 2009 identified conditions for a strong case to act on climate change, and called for more work to fully account of the relevant economics and how it affects human welfare.

- According to John Baden "the improvement of environment quality depends on the market economy and the existence of legitimate and protected property rights."
- They enable the effective practice of personal responsibility and the development of mechanisms to protect the environment. The State can in this context "create conditions which encourage the people to save the environment."

Bussiness-

- Money-profit-
- Socio-efficiency

Income

Architecture

Politics

Bussiness

- Both eco-efficiency and socio-efficiency are concerned primarily with increasing economic sustainability.
- In this process they instrumentalize both natural and social capital aiming to benefit from win-win situations.
- However, as Dyllick and Hockerts point out the business case alone will not be sufficient to realise sustainable development.
- They point towards eco-effectiveness, socio-effectiveness, sufficiency, and eco-equity as four criteria that need to be met if sustainable development is to be reached.

Income

- Sustainable development as well as solidarity can impact reduce the poverty. Because over many thousands of years the ‘stronger’ (economically or physically) used to defeat/eliminate the weaker, nowadays, no matter what we call the reason for this decision – within Catholic social solidarity, and sustainable development – the stronger helps the weaker.

- This aid may take the form of in-kind or material, refer to the present or the future. ‘The Stronger’, should offer real help and not, as demonstrated by the frequent experience .
- Sustainable development reduce poverty through economic (among other things, a balanced budget), environmental (living conditions) and also social (including equality of income) dimensions.

Architectur

- In sustainable architecture the recent movements of New Urbanism and New Classical Architecture promote a sustainable approach towards construction, that appreciates and develops smart growth, architectural tradition and classic Design.
- This in contrast to modernist and international style architecture, as well as opposing to solitary housing estates and suburban sprawl, with long commuting distances and large ecological footprints.
- Both trends started in the 1980s. (It should be noted that sustainable architecture is predominantly relevant to the economics domain while architectural landscaping pertains more to the ecological domain.)

Politics

- A study concluded that social indicators and, therefore, sustainable development indicators, are scientific constructs whose principal objective is to inform public policy-making.
- The international institute of sustainable Development has similarly developed a political policy framework, linked to a sustainability index for establishing measurable entities and metrics.
- The framework consists of six core areas, international trade and investment, economic policy, climate change and energy, measurement and assessment, natural resource management, and the role of communication technologies in sustainable development.

- The United Nation Global Cities Programme has defined sustainable political development is a way that broadens the usual definition beyond states and governance. The political is defined as the domain of practices and meanings associated with basic issues of social power as they pertain to the organisation, authorisation, legitimation and regulation of a social life held in common.

- This definition is in accord with the view that political change is important for responding to economic, ecological and cultural challenges. It also means that the politics of economic change can be addressed. They have listed seven subdomains of the domain of politics:

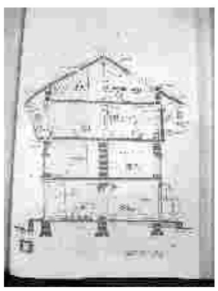
- Organization and governance
- Law and justice
- Communication and critique
- Representation and negotiation
- Security and accord
- Dialogue and reconciliation
- Ethics and accountability

Culture

- the Agenda 21 for Culture and the united cities and local government (UCLG) Executive Bureau lead the preparation of the policy statement "Culture: Fourth Pillar of Sustainable Development", passed on 17 November 2010, in the framework of the World Summit of Local and Regional Leaders – 3rd World Congress of UCLG, held in Mexico City. although some which still argue that economics is primary, and culture and politics should be included in 'the social'.

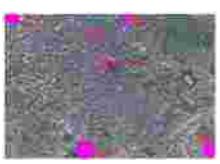
- This document inaugurates a new perspective and points to the relation between culture and sustainable development through a dual approach: developing a solid cultural policy and advocating a cultural dimension in all public policies.
- The circles of sustainability approach distinguishes the four domains of economic, ecological, political and cultural sustainability.

Traditional Building



Traditional Buildings in Kirtipur

Traditional Cities



Traditional Cities

Festivals

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Open Spaces

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Traditional Water Supply

12/22/2016 45

Lane

12/22/2016 46

Urbanization in Nepal

•According to the census 2011, a population of Nepal is 26.66 million with an annual growth rate of 1.35 per cent.

•The population density is 180 per square km and the literacy rate is 65.9 per cent.

Source: (CBS, 2011)

Urbanization in Nepal

Before 1952 there were only seven municipalities and in 1952 ten towns were defined as municipalities with a population over 5000.

The urban population is the inhabitants residing in the designated municipal areas. Population size has been taken as the principal criteria in selection of urban areas in Nepal.

Urbanization in Nepal

The *Nagar Panchayat* Act 1962 provided classification of Nagar as the local administrative unit or a municipal area.

It is stipulated a population not less than 10000.

Urbanization in Nepal

Urban Definition

•Only in 1961 census provided the formal definition of urban areas.

• 16 municipalities having population size of 5000 with the facilities of high school, colleges, judicial and administrative offices, communication facilities, bazaar, mills, factories etc.

(Pradhan, 2003).The *Nagar Panchayat* Act 1962

Criteria for city / urban area

In Nepal,

- Municipalities are referred as Cities or urban area, the criteria for municipalities are set by Local Self Governance Act ,LSGA (1999)

"A geographic area with population of 20,000 or more and basic urban services can be declared as municipality".

Classification of municipalities as per LSGA:

a. Municipality:

b. Sub metropolitan city

c. Metropolitan city

Criteria for municipalities in Nepal as per LSGA 2055

	Population	Annual income	Services
Municipality	20,000 (10, 000 for hills & mountains)	Rs. 50 lac (5 lac for hills / mountain)	Electricity, w/s, telecom, & other urban services [even without road service at hills & mountains)
Sub metropolitan	1,00,000	Rs. 10 crore	metalled **major road**,hospitals, ordinary international sports infrastructure, higher level education * **Earlier Municipality**
Metropolitan	3,00,000	Rs.40 crore	metalled **major & minor road,** specialized hospitals, special international sports infrastructure, **university** for multiple higher level education, city hall * **Earlier Sub metropolitan**

Urbanization in Nepal

•Nepal is one of the least urbanized countries of Asia

•The pace of urbanization is very fast.

•Only 17.1% of Nepal's population resided in 58 municipalities in 2011.

•With the addition of 131 municipalities in 2014, 38.26% of Nepal's population reside in 191 municipalities.

•Urban growth rate of 3.43% excludes
•Newly graduating urban areas and expansion outside municipal limits.

Urbanization Nepal

• Kathmandu Valley is the hub of Nepal's urbanization with nearly 24% of national urban population.

•Regional levels of urbanization vary remarkedly with high levels of urbanization in valleys and inner Tarai relative to the more economically potential Tarai.

• Urbanization is dominated by few large and
•medium cities in the hills.

Urbanization in Nepal

•Population comparisons can be misleading because municipal designation is a political decision which often ignores functional criteria.

• In 2014, 133 new municipalities irrespective of their functional attributes have been added to the municipal category bringing the number of municipalities to 191 and urban (municipal) population to 38.26% of the total.

Urbanization of Nepal

•According to the 2011 census, Kathmandu Metropolitan City has million plus which has 9.72% of national urban population.

• Pokhara Sub Metropolitan City, the second largest municipality in the country has 3.13% of total national urban population.

• Gross population density is also low in most municipalities.

•With addition of new municipalities and sub-metro cities,58 existing municipalities and 113 new municipalities have population densities less than 10 ppha,

Source: (NUDS,2015)

Urbanization in Nepal

High urban growth (over 4%) locations characterize Kathmandu and Pokhara valleys, Inner Tarai valleys and locations along major road corridors.

In the last decade,only 7 municipalities (Damak, Itahari, Bharatpur, Thimi, Pokhara, Kirtipur, Birendranagar) had growth rates above 5%.

It is seen that physiography and connectivity are important determinants of urbanization.

Urbanization Nepal

- A medium growth rate is estimated for population projection for the existing 58 municipalities during 2011 The growth rate is taken 2.8% per annum.

- However, rapidly urbanizing municipalities are expected to have a growth rate of 3.5% and an urban population share of about 60%.

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Urbanization Nepal

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	Urban Places				Distribution of Urban Population (%)				Level of urbanization				Annual growth rates		
Regions	1981	1991	2001	2011	1981	1991	2001	2011	1981	1991	2001	2011	1981-91	1991-01	2001-11
Mountain	[illegible]	0	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	0	0	3.6	3.8			[illegible]
Hill	5	13	27	27	51.7	51.2	53.2	54.3	5.9	13.3	16.7	21.7	5.9	7.1	3.7
Tarai	14	20	29	29	48.3	48.8	45.5	44.3	7.0	9.8	[illegible]	15.1	6.5	5.3	3.2
Nepal	23	33	58	58	100	100	100	100	6.4	9.2	13.9	17.1	7.5	6.6	3.4
EDR	7	9	14	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CDR	7	10	20	20	32.7	34.4	43.7	52.2	[illegible]	14.9	20	23.5	11.2	5.7	[illegible]
WDR	4	5	12	12	11.9	12.1	13.1	13.9	[illegible]	5.6	[illegible]	15.5	[illegible]	9.5	[illegible]
MWDR	[illegible]	[illegible]	6	5	7.3	5.3	7.2	7.1	3.5	4	7.7	9.1	3.6	10.3	2.4
FWDR	[illegible]	[illegible]	[illegible]	[illegible]	4.4	[illegible]	[illegible]	2.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NUDS, 2015

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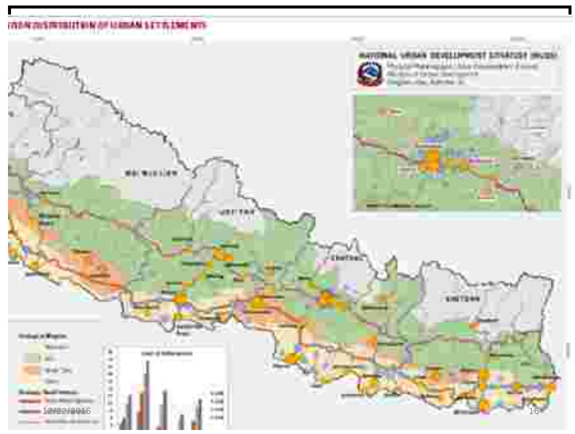

16

Urban Problem

- As increased urbanization the level of urbanization is very low.
- The urban database is poor.
- Unbalanced urban system
- Poor integrated
- Urban sprawl
- Informal urban growth
- Lack of urban infrastructure and services.

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Urban Problem

- Urban environment degradation
- Rising urban poverty.
- Weak institutional capacity for urban planning

Management.

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Urban Problem

•Deficiency of urban infrastructures is highlighted by the situation of water supply, sanitation, solid waste management, housing, transport and energy-electricity.

•There is also considerable disparity among ecological regions.

• Only 32.9% of households have access to piped water supply in urban Tarai as compared to 81.2% of households in urban hill.

Urban Problem

•The quality and quantity of drinking water is insufficient in all urban regions.

• To meet the MDG target of water for all by

•2017, substantial investment to the tune of Rs 7.5 billion per annum is required to be spent.

•

•Conditions of sanitation system and solid waste management are also critical.

Urban Problem in Nepal

•Only 56.1% of urban households have access to sanitation system with 88.2% households having access to toilets.

•Likewise, out of 58 municipalities, only 6 have sanitary landfill sites and only 5 practice controlled waste dumping.

Urbanization Nepal

•The growth rate in the inter-censal decade was 3.43%.

•The average annual growth between 1981-2011 has remained at a high rate of 5.3%.

Urbanization Nepal

Of the total electricity produced, 42.5 % is consumed by the residential sector industrial sector consumes 37.7% (MoF, 2012).

A major portion of residential energy is consumed in urban areas. Per capita electricity consumption in Nepal in 2010 was 90 KWh, compared to 566 KWh in India and 719 KWh for Asia.

Kathmandu valley alone consumes 29.23% (or over 200 MW) of the total electricity distributed by NEA

Urbanization Nepal

Urban Economy

The demographic and economic characteristics of urban areas provide a picture of the urban economy.

Economically active population above 10 years make up 36% of urban population, 34% is usually active (23% male and 11% female). Around 44% are economically inactive, of which males account for 16% and females 28%.

Urbanization Nepal

•Agriculture, forestry and fishing accounted for almost a third of the total urban employment. Wholesale, retail trade (17%) and manufacturing (14%) are the other two important

•employment sectors.

• But the urban sectoral employment varies a great deal among urban areas.

• In larger urban areas trade and services are the prominent sectors of employment followed by manufacturing.

Urbanization Nepal

•The housing occupancy status in 2010/11 shows that nearly 90 percent of households reside in their own house.

• Only 69 percent reside in their own house in urban areas, a decline of 3 percent from 2003/04.

Urbanization Nepal

• The situation in Kathmandu valley shows that there has been 14 percent decline in owner households between 2003/04 and 2010/11. Rental households meanwhile have increased by 15% .

•According to the National Housing Plan 2013/14 out of the 10.45 lakh households in urban areas only 56.8% had own houses and 40.2% of housing units were rented.

Urbanization Nepal

literacy rate is 65.9 per cent. The male literacy is 75.1 per cent and female 57.4 per cent. The life expectancy rate of males is 68 years and that of females 69 years.

Urbanization Nepal

Dwelling Size

According to NLSS 2010/11 average dwelling size in urban

area has decreased from 584 sq ft to 571 sq ft since 2003/

04.

In case of Kathmandu Valley it has decreased from 589

to 555 sq ft.

- Average dwelling size in Kathmandu Valley is slightly lower than that of other urban areas.
- However, the average area of housing plot has increased from 1162 sq ft to 1224 sq ft in case of Kathmandu Valley.

Urbanization Nepal

Demand

As per National Shelter Plan 2013/14, the projected number of housing units required in urban area is around 1,364,000 with around 900,000 new construction required by 2023.

Urbanization Nepal

Housing Trend

•In the last one and a half decade the private sector has emerged as an active player in the urban housing.

•Around 62 housing projects (Group Housing and Apartments) with 6113 housing units are being implemented within Kathmandu Valley since 2012.

(MoUD 2013)

Thank You !

STUDIO INVESTIGATIONS

STUDIO NEPAL
Town Extensions in Kathmandu Valley

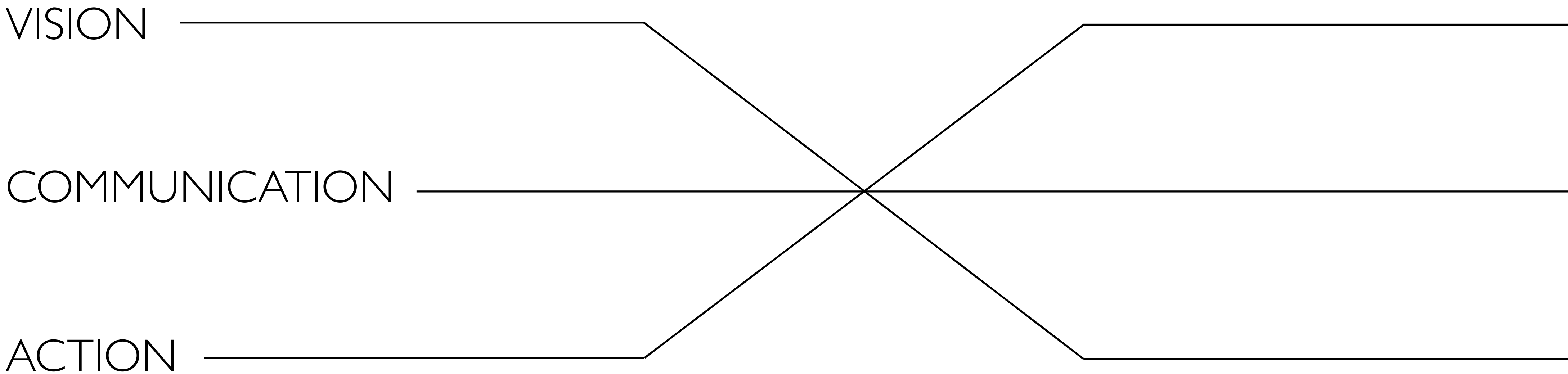
Urban design investigations into a hazardous territory experiencing fast growth

Spring Studio 2016, Kathmandu, Nepal

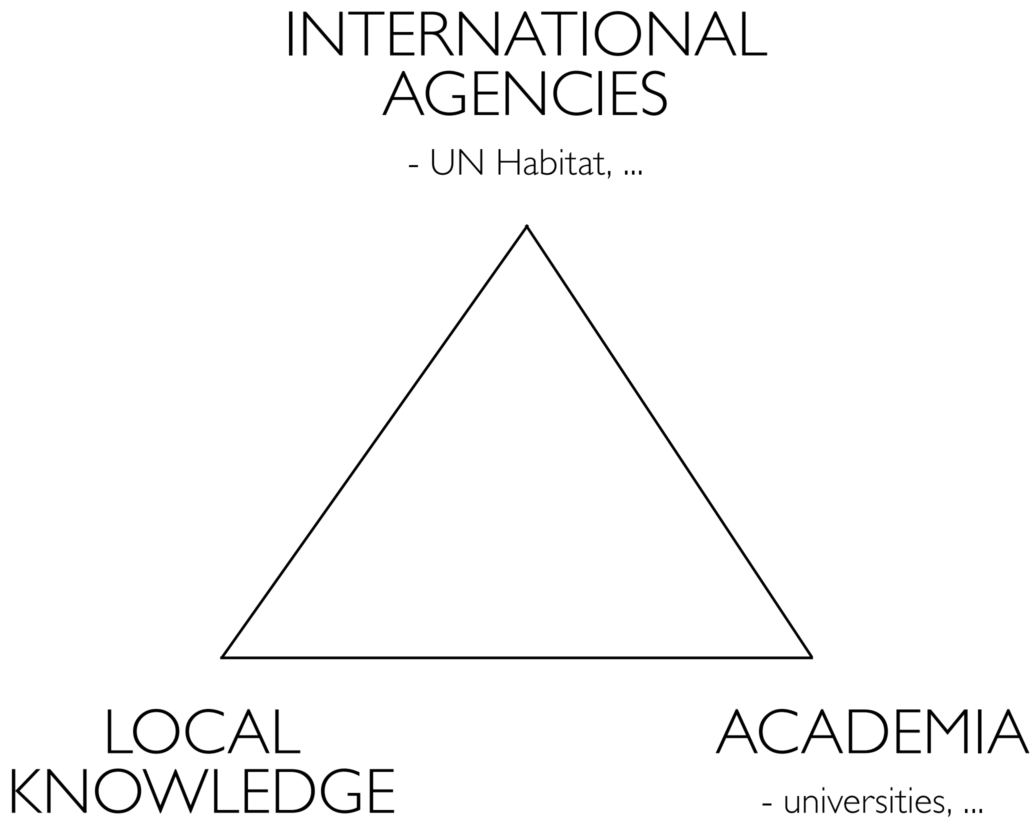
2016 University of Leuven, Master of Human Settlements, Master of Urbanism and Strategic Planning
Bruno De Meulder, Viviana d'Auria, Annelies De Nijs, Stefanie Dens

2016 Tribhuvan University, Master of Energy for Sustainable Social Development
module 2: energy in sustainable urban and rural planning
Sangeeta Singh, Dr. Sushil B. Bajracharya

TRIALOGUES



TRIALOGUES

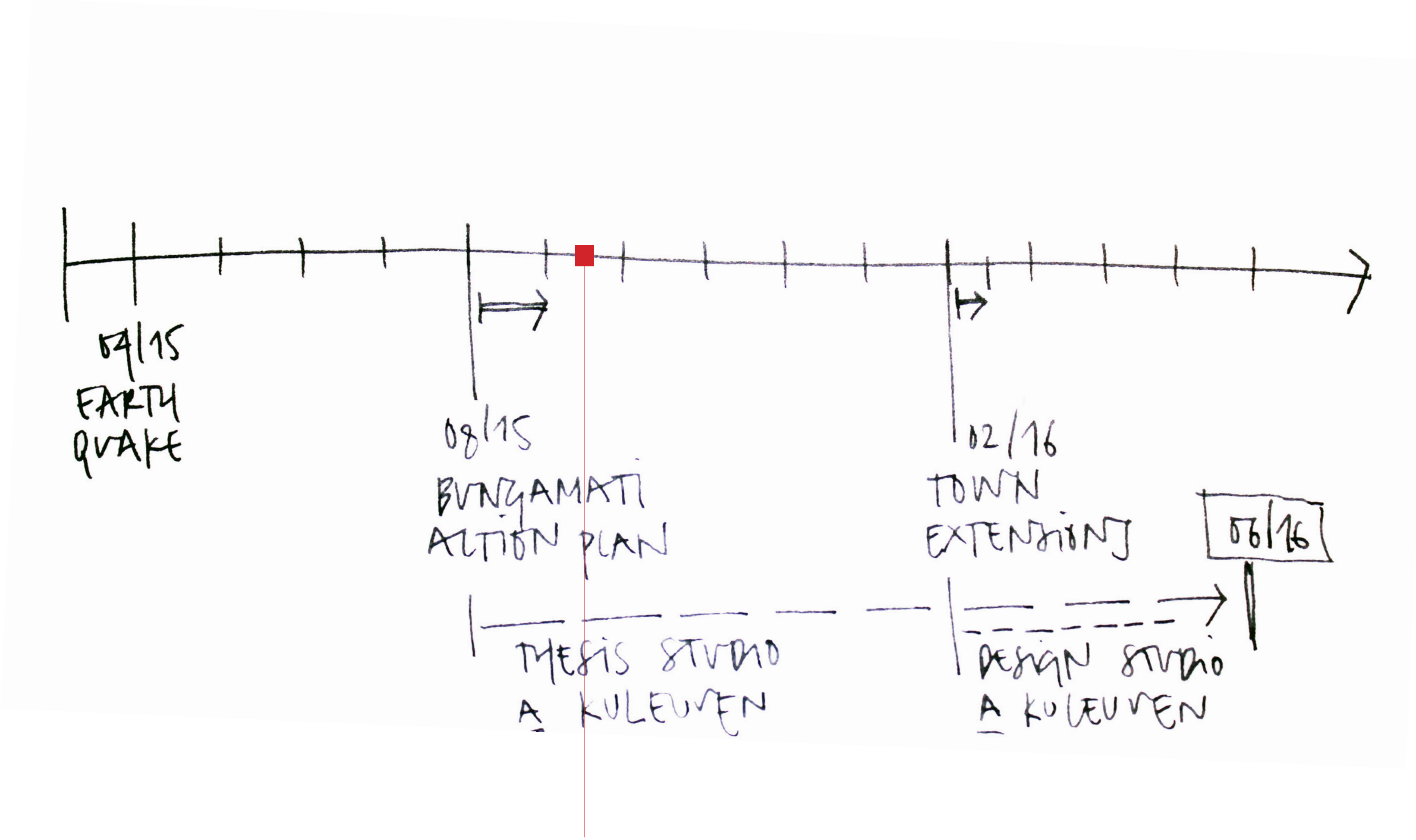

INTERNATIONAL AGENCIES
- UN Habitat, ...
LOCAL KNOWLEDGE
ACADEMIA
- universities, ...

CO-PRODUCING THE CITY

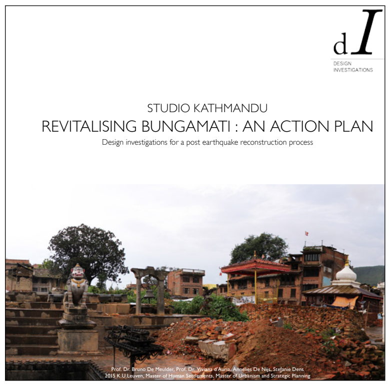
Coproducing knowledge

1. TIMING

TIMING
2 studios



Publication Bungamati Action Plan



methodology

fieldwork as a tool
interpretative mapping as a presentation

data from the field, by interviews, measuring, making observations, sketching, ...

with this data: come to a grounded design strategy

2. STUDIO BRIEF

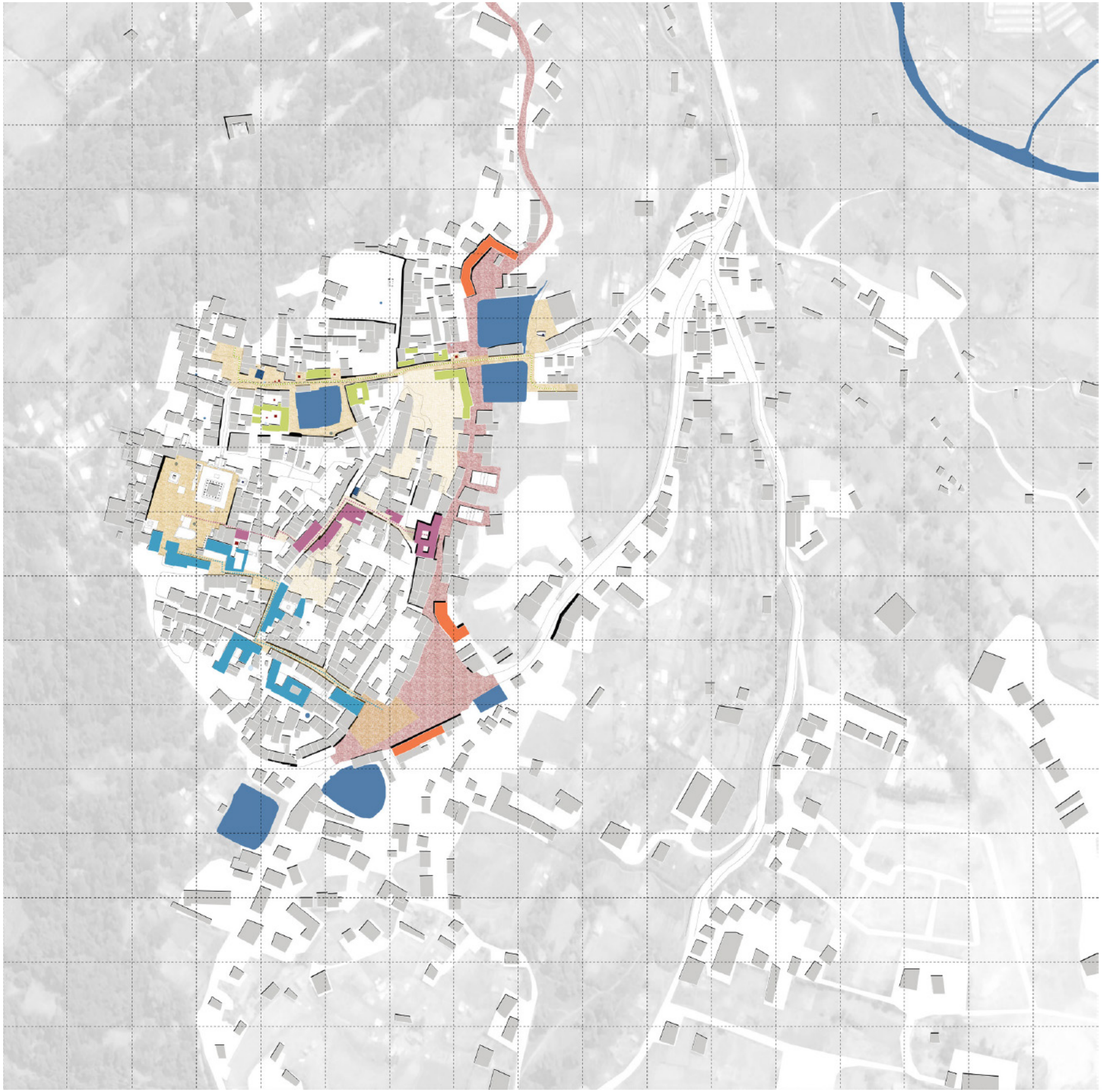
Bungamati action plan

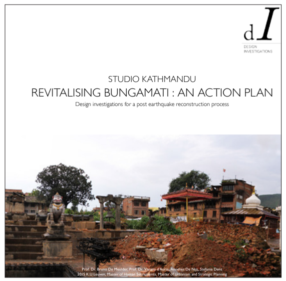
action plan for reconstruction

bottum up

town revitalisation

sequence of reconstruction activitities



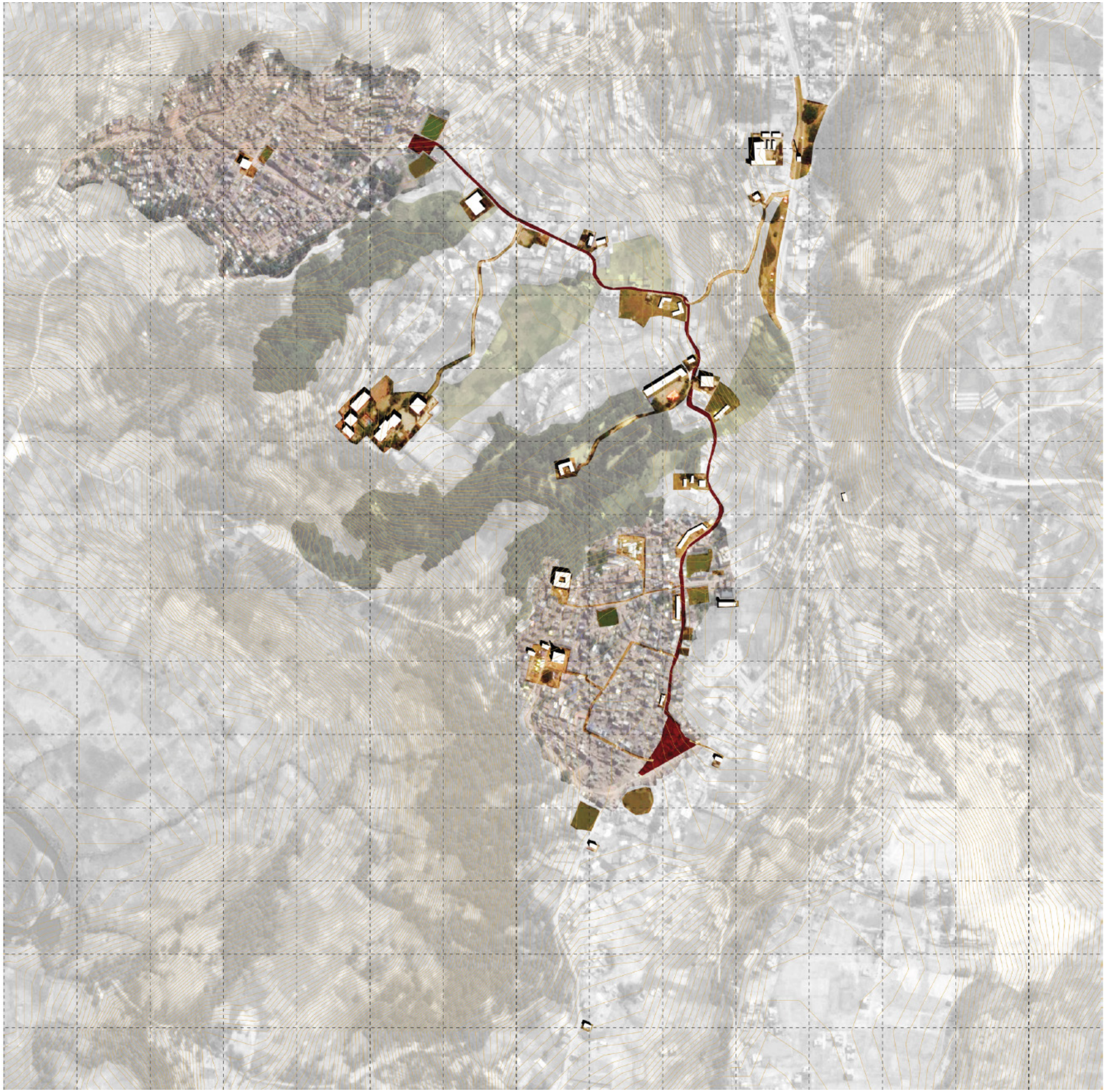


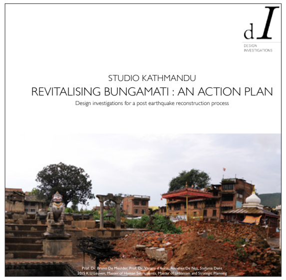
Bungamati action plan

vision on larger scale

Bungamati and Khokana as a twin village

how can this structure receive new urban growth?



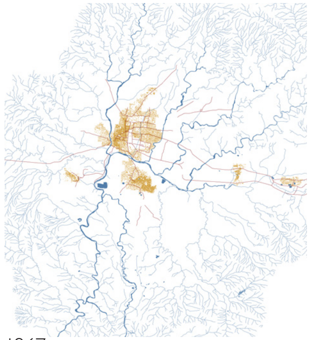


town extensions
complementary work

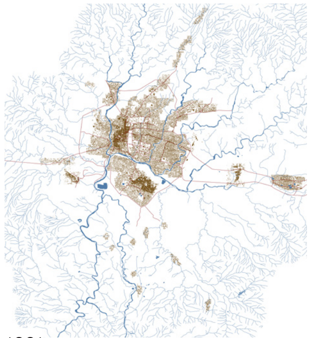
massive urban growth

urban pressure in fringes of city

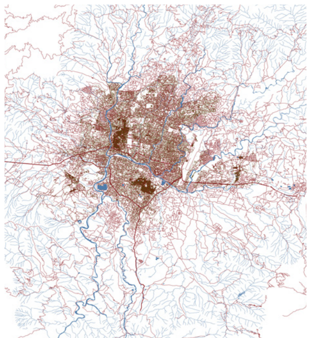
30 000 years ago



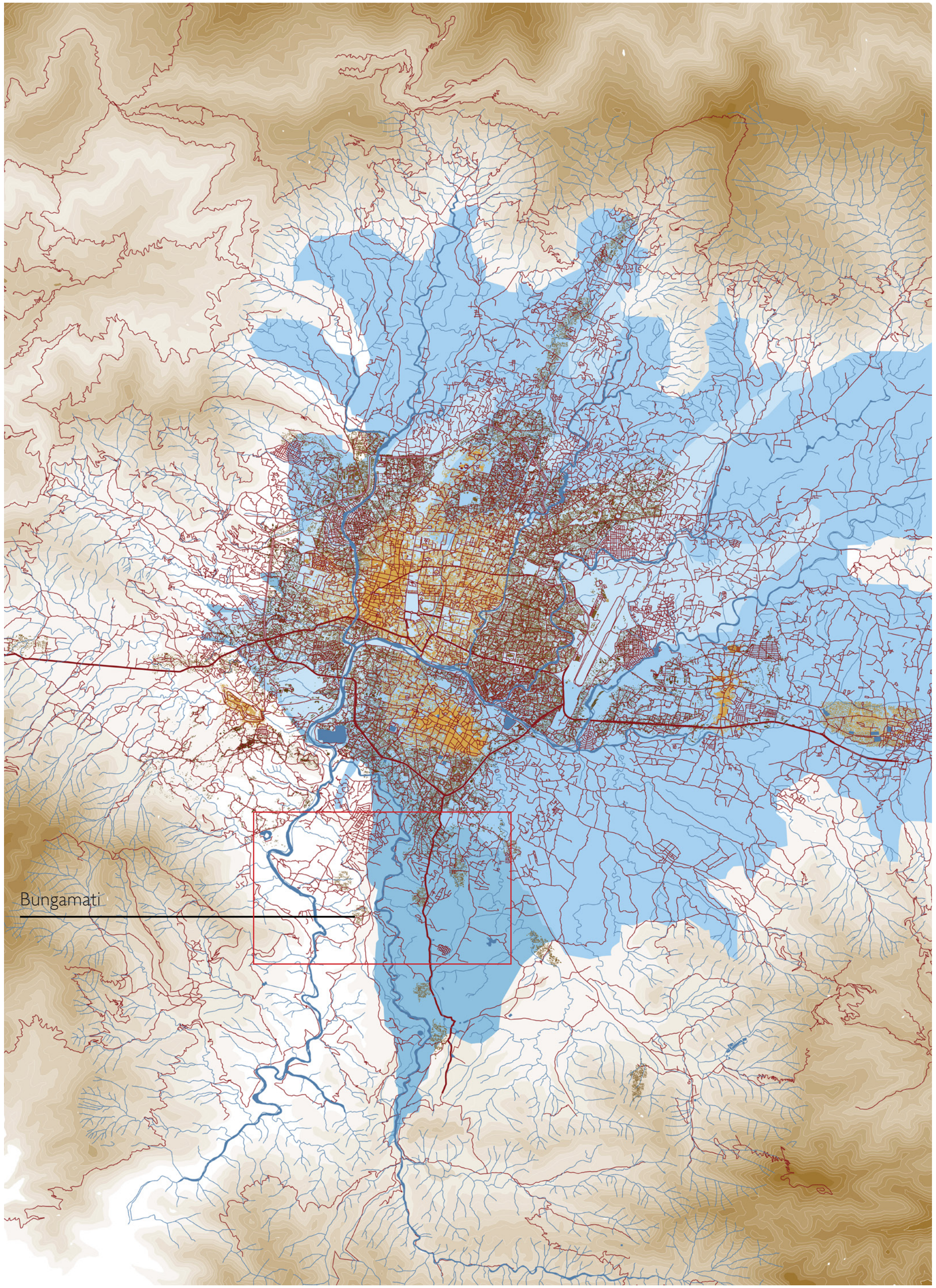
1967



1991

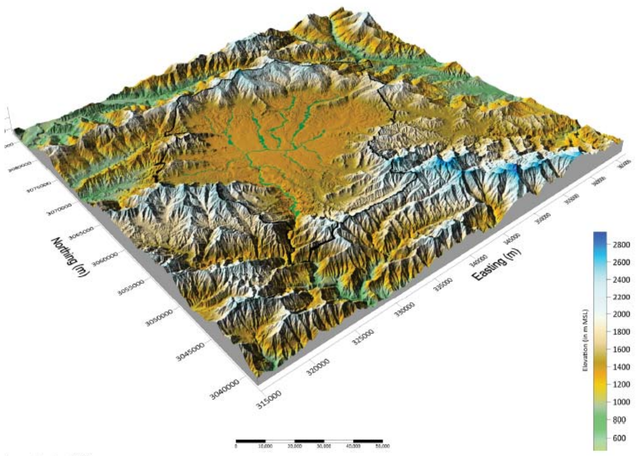


2014



Evolution of the Kathmanu Valley *- from lake to condensed city plain*

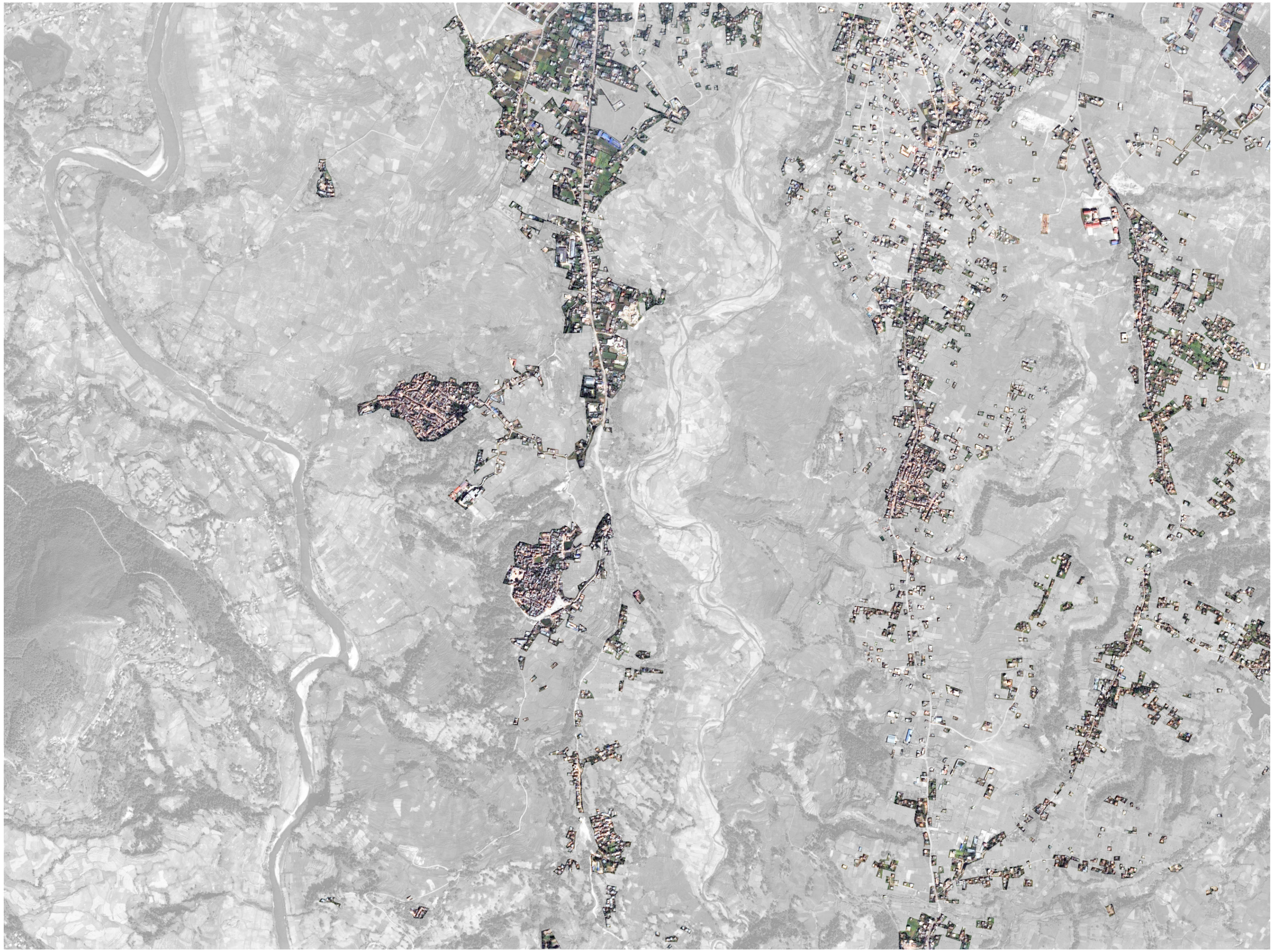
0 4 km



town extensions
complementary work

massive urban growth

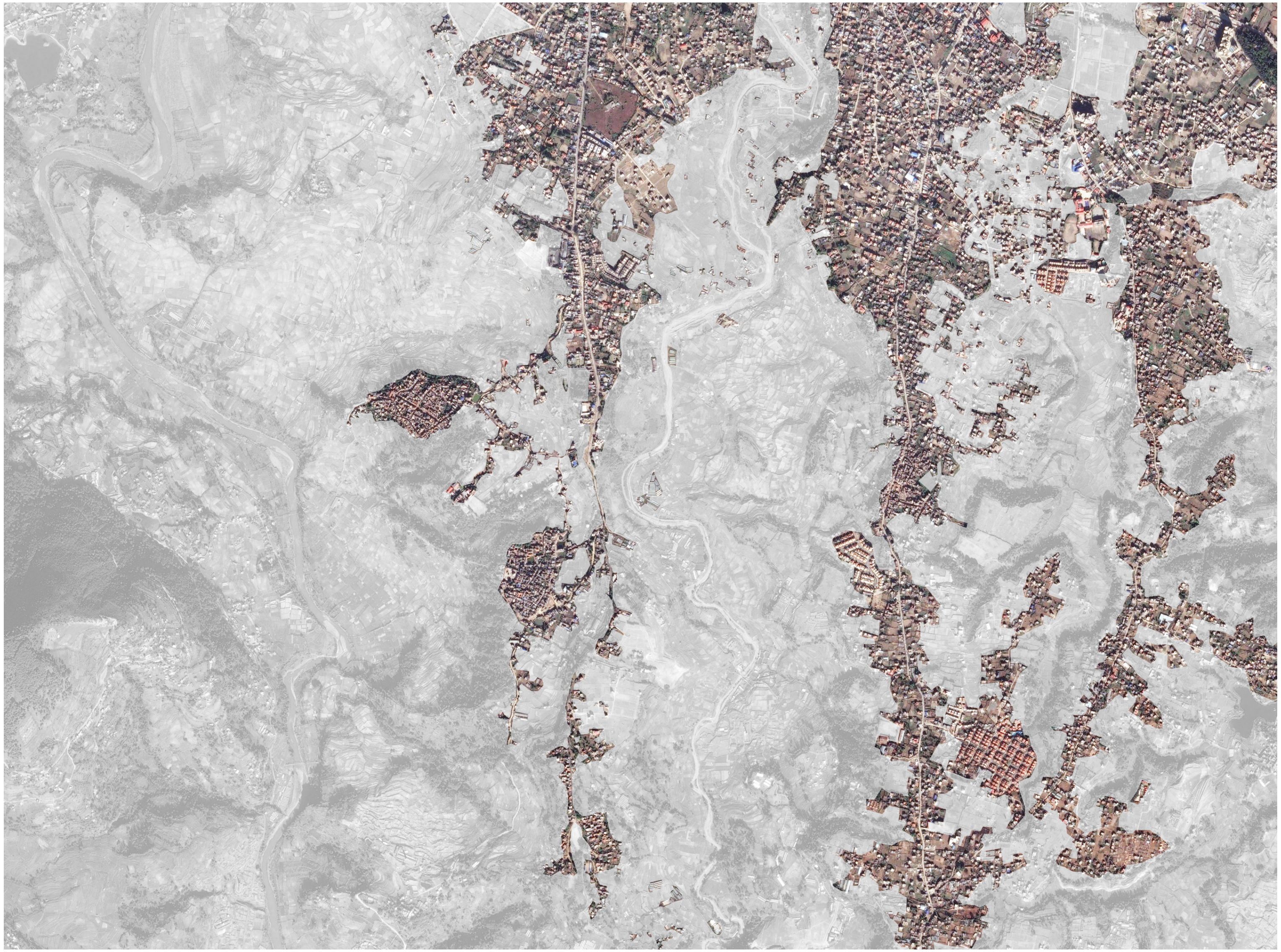
urban pressure in fringes of city



town extensions
complementary work

massive urban growth

urban pressure in fringes of city



town extensions
complementary work

growth that leads to real estate speculation
and stamps upon the land

town extensions
problem statement

land speculation

preparation of large plots

rough edge conditons, lack of integration

town extensions
problem statement

the rise of monofunctional compounds

big contrasts within the urban tissue

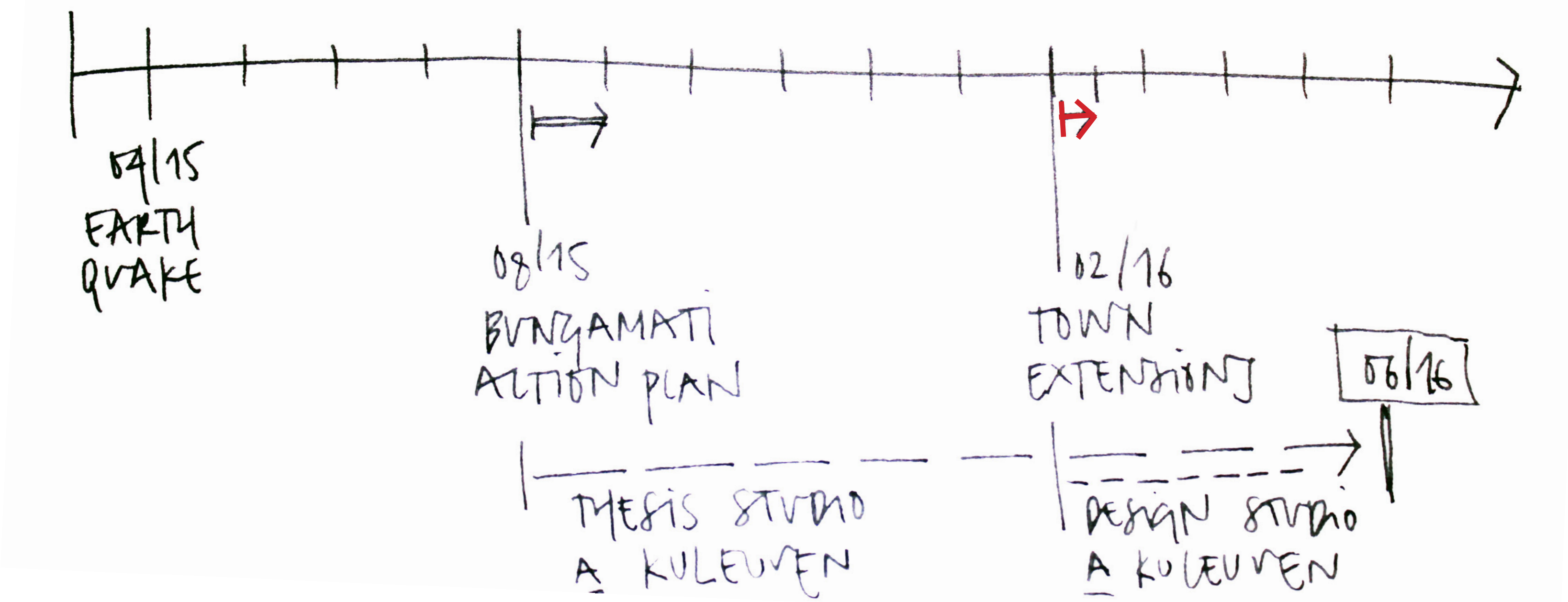
uncontrolled sprawl ?

town extensions
fieldwork

fieldwork as a preparation of a studio semester: 2 exercises

exercise 1 :
- 3 days of fieldwork
- in collaboration with Tribhuvan University

exercise 2:
- 3 days of fieldwork
- KULeuven



2 weeks of fieldwork in Kathmandu,
followed by 15 weeks of studio in Leuven

town extensions
fieldwork exercise

EXERCISE 1 : 3 STRIPS WITH NEW URBAN DEVELOPMENTS

1. URBAN STRIP : Kohinoor Housing (with future ring road)

2. PERI-URBAN STRIP : Vinayak Colony Road (with future ring road)

3. RURAL STRIP : Jarunchaa Colony Road

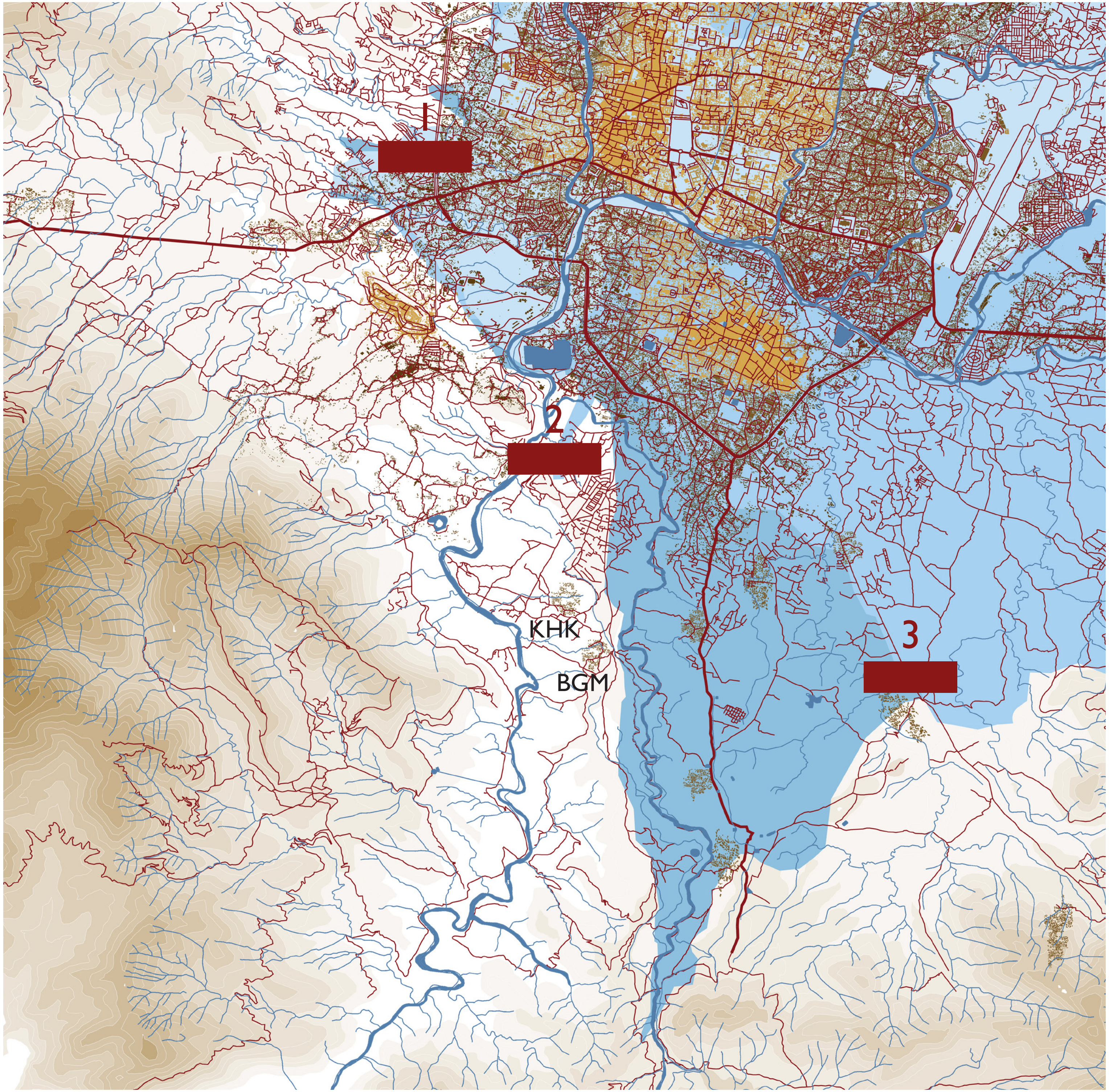
each strip 2 by 0,5 kilometers

AIM

evaluate contemporary urban tissues in relation to traditional and vernacular ways of living

RESEARCH TOPICS

- public space
- figure ground and densities
- developers logics
- interaction with surrounding built space
- connectivity / relation to city centre
- appropriation
- social structure
- amenities
- infrastructure / energy / waste / ...



town extensions
fieldwork exercise

EXERCISE 1 : 3 STRIPS WITH NEW URBAN DEVELOPMENTS

1. URBAN STRIP : Kohinoor Housing (with future ring road)

KULEUVEN PARTICIPANTS

2 weeks

TRIBHUVAN UNIVERSITY

8 days, 18-26 february

town extensions
fieldwork exercise

EXERCISE 1 : 3 STRIPS WITH NEW URBAN DEVELOPMENTS

2. PERI-URBAN STRIP : Vinayak Colony Road
(with future ring road)

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town extensions
fieldwork exercise

EXERCISE 1 : 3 STRIPS WITH NEW URBAN DEVELOPMENTS

3. RURAL STRIP : Jarunchaa Colony Road

KULEUVEN PARTICIPANTS

2 weeks

TRIBHUVAN UNIVERSITY

8 days, 18-26 february

town extensions
fieldwork exercise

EXERCISE 2 : 6 THEMES AROUND THE BUNGAMATI KHOKANA AREA

1. water, productive landscape and flows

2. urban tissue, typologies and appropriation

3. public space and infrastructure

town extensions
fieldwork exercise

2 COMPLEMENTARY EXERCISES

- strips : background on urbanisation logics

- Bungamati-Khokana: a status quo

Both exercises will lead to grounded design strategies that will be developed troughout the coming semester

EXERCISE 1 : 3 STRIPS WITH NEW URBAN DEVELOPMENTS

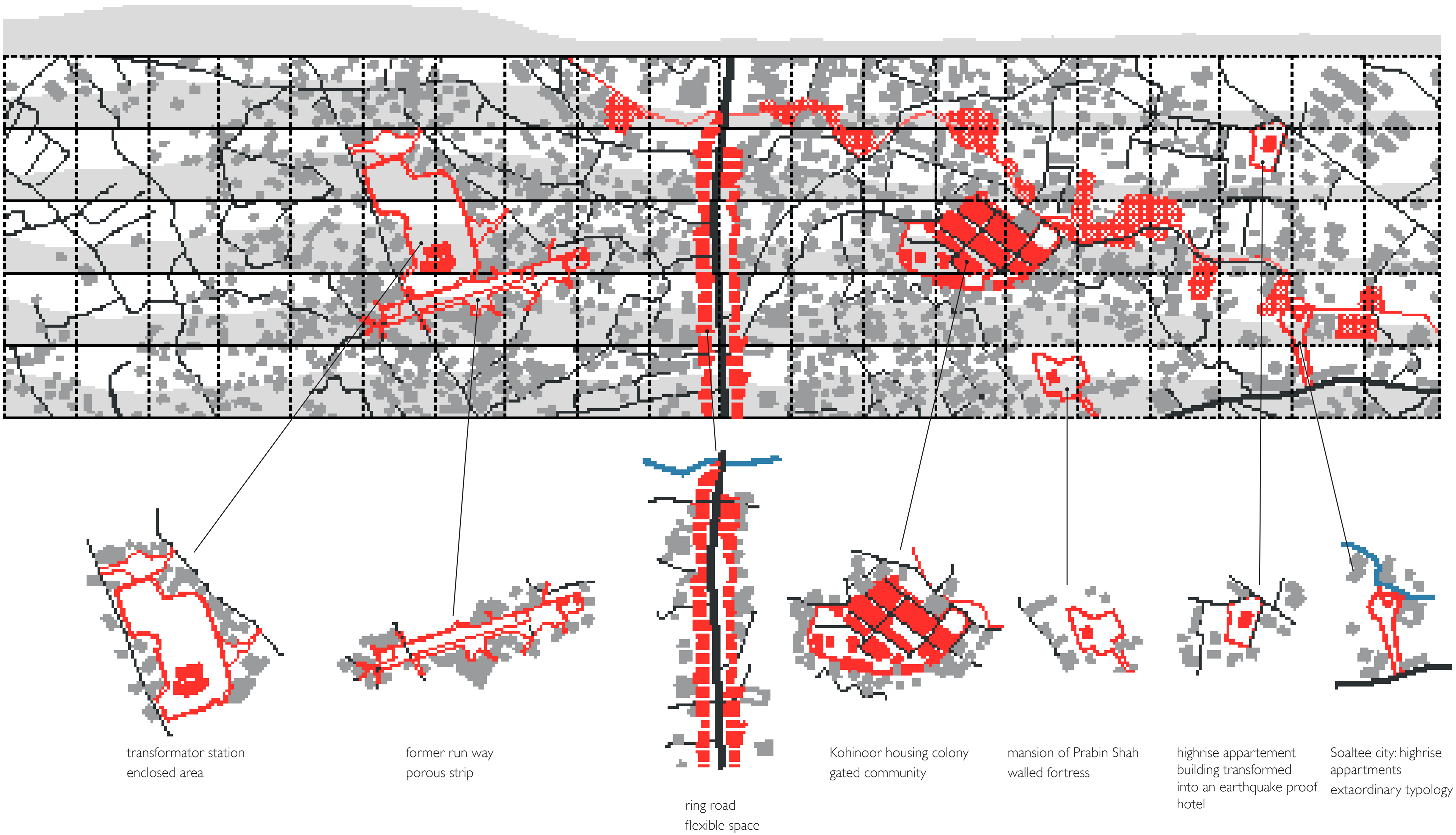
EXERCISE 2 : 6 THEMES AROUND THE BUNGAMATI KHOKANA AREA

3. OUTCOMES OF THE EXERCISE ON THE STRIPS

town extensions
fieldwork exercise

STRIP 1
the urban condition

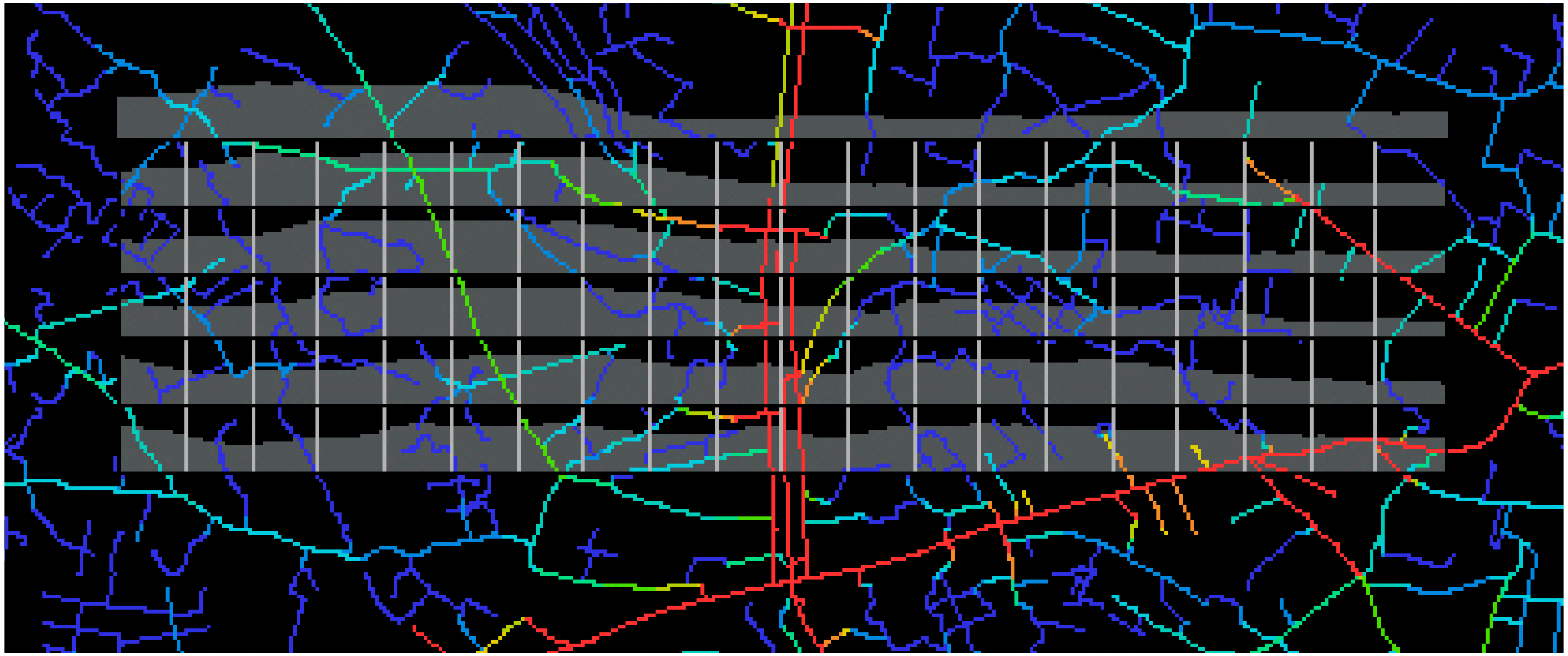
generic & extraordinary

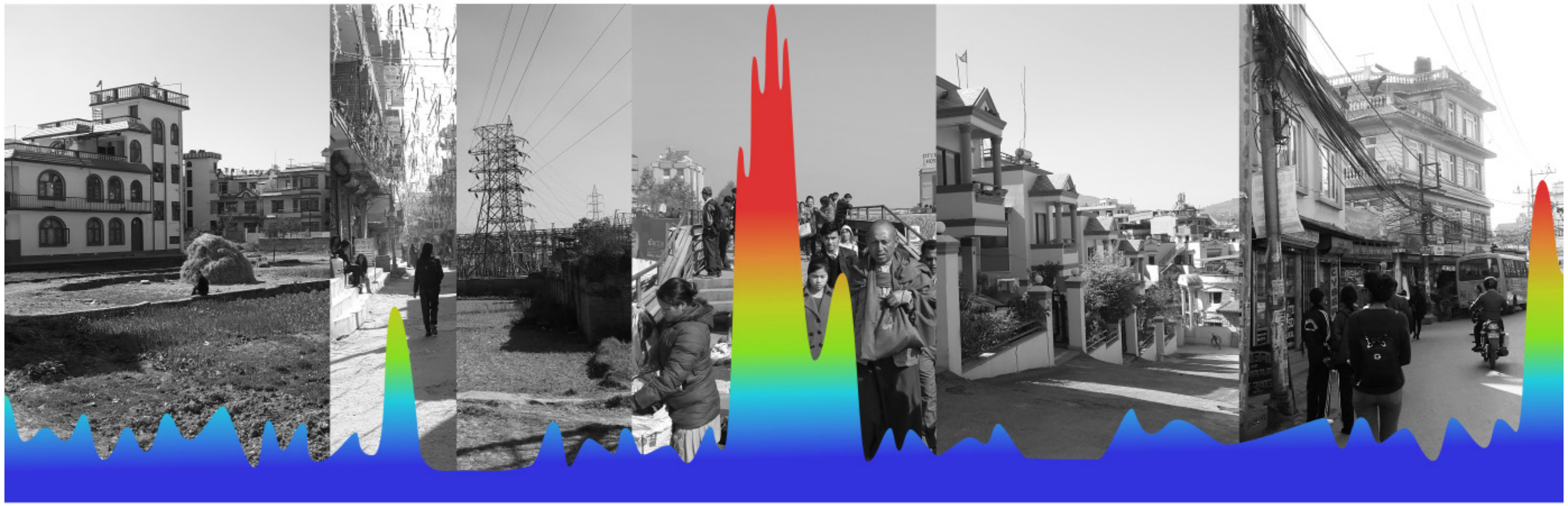


Does the extraordinary structure the generic?

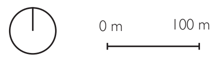
0 m 100 m

Intensity of public flux

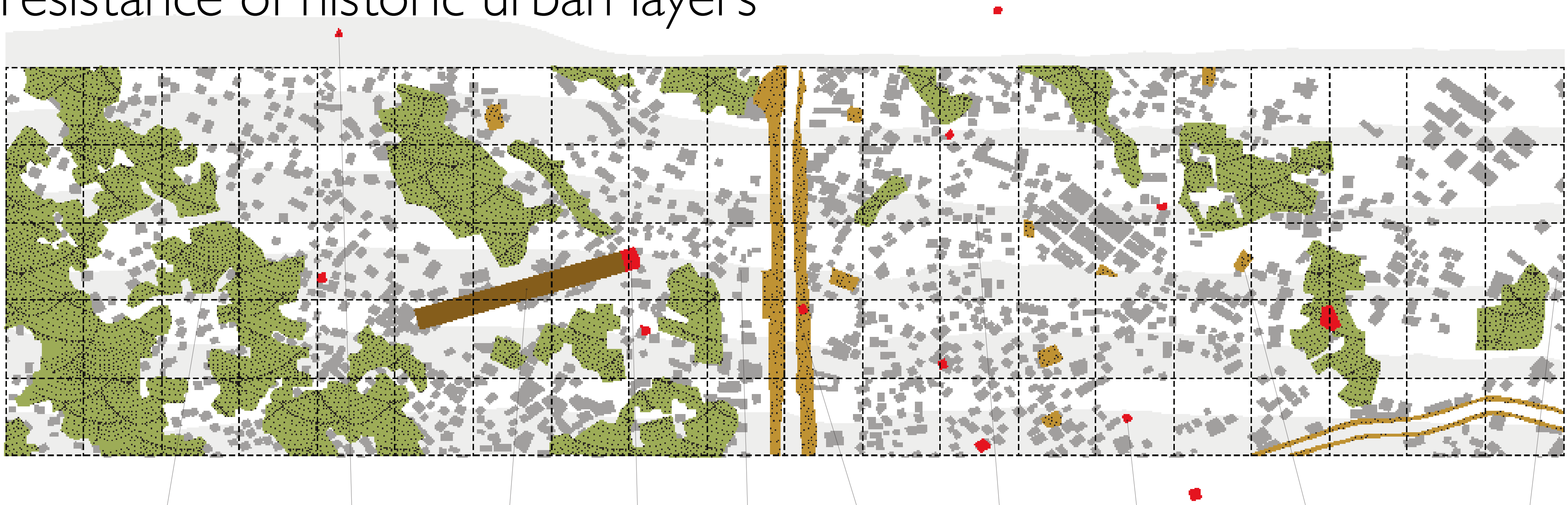




Does the public flux organize the open space?



resistance of historic urban layers



guthi: agriculture land collectively owned by a group of people

pathi: public space for relaxation

former airstrip is used as a flexible public space

temple

private front yards

kalanki bridge used as a market

along the ring road a wide variety of activities is taking place

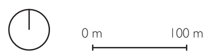
in dense urban areas streets are public spaces

water wells

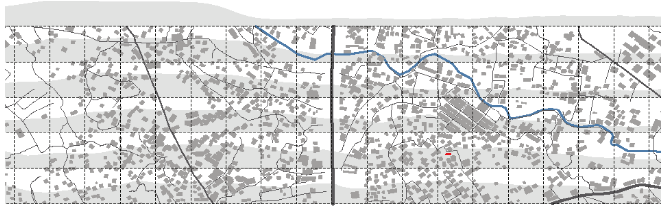
vacant plots are used as temporary sportfields

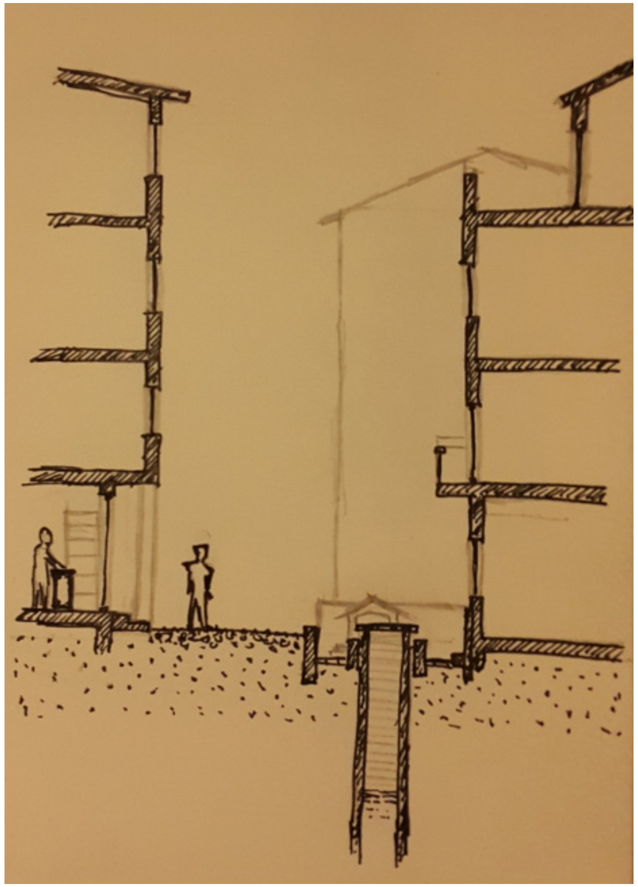
Chaitya futsal: people can rent a shaded football field

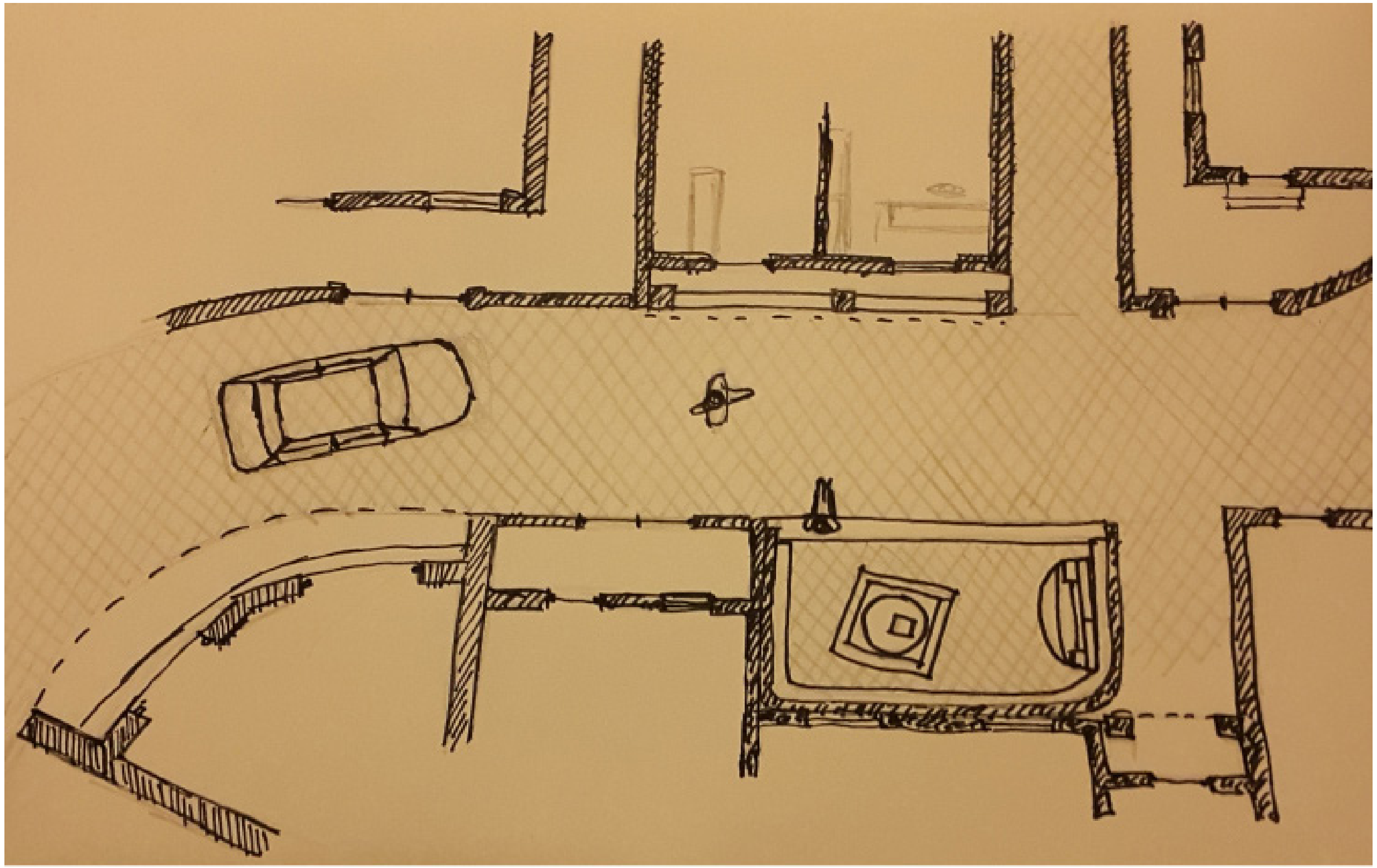
Will the vernacular resist the contemporary?



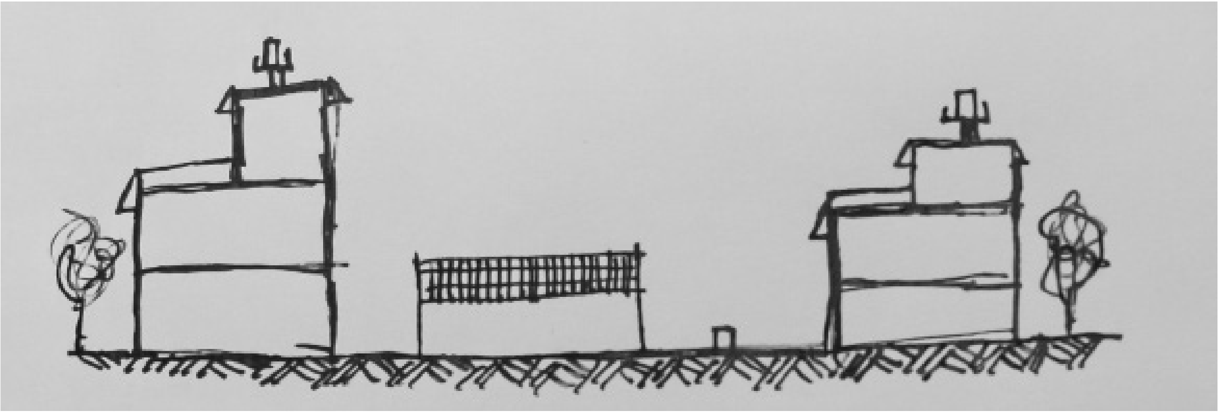
appropriateness of sizes: well

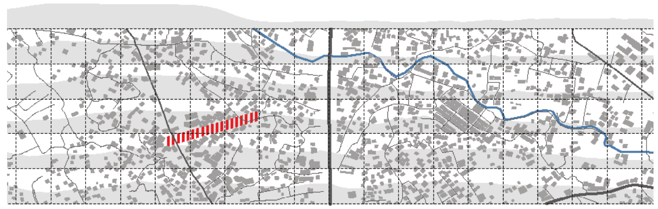


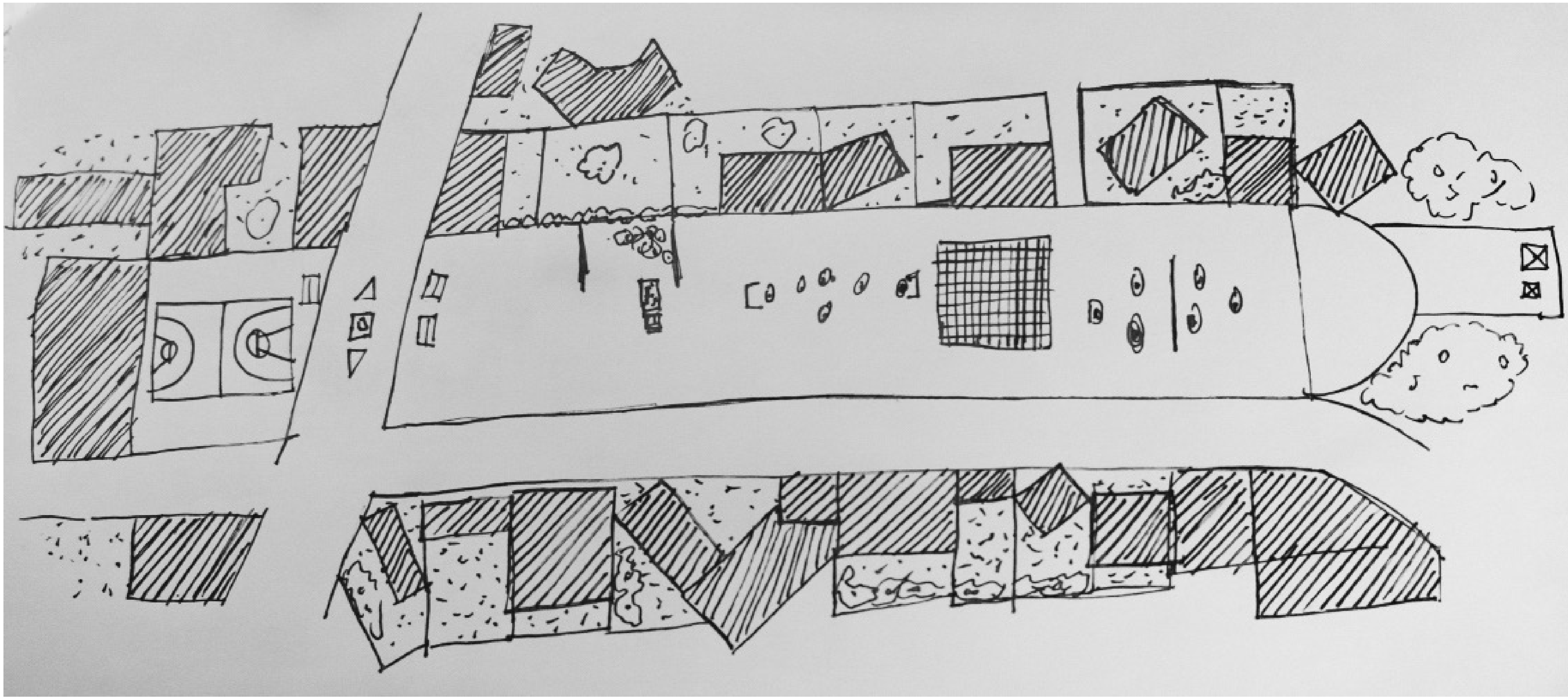




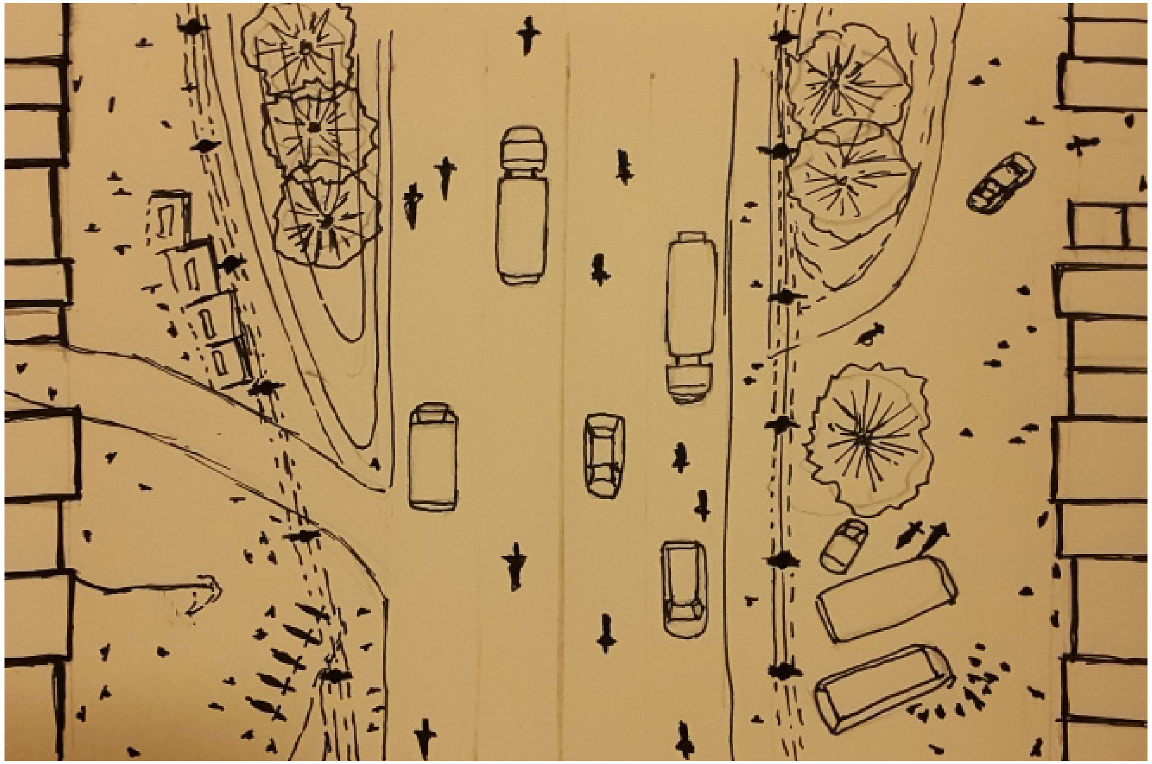
appropriateness of sizes: airstrip

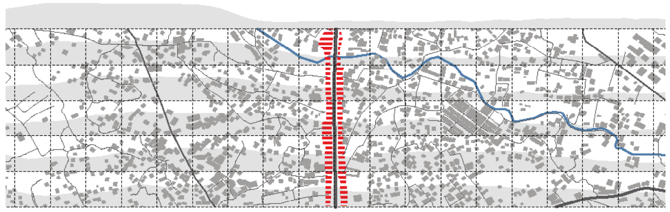


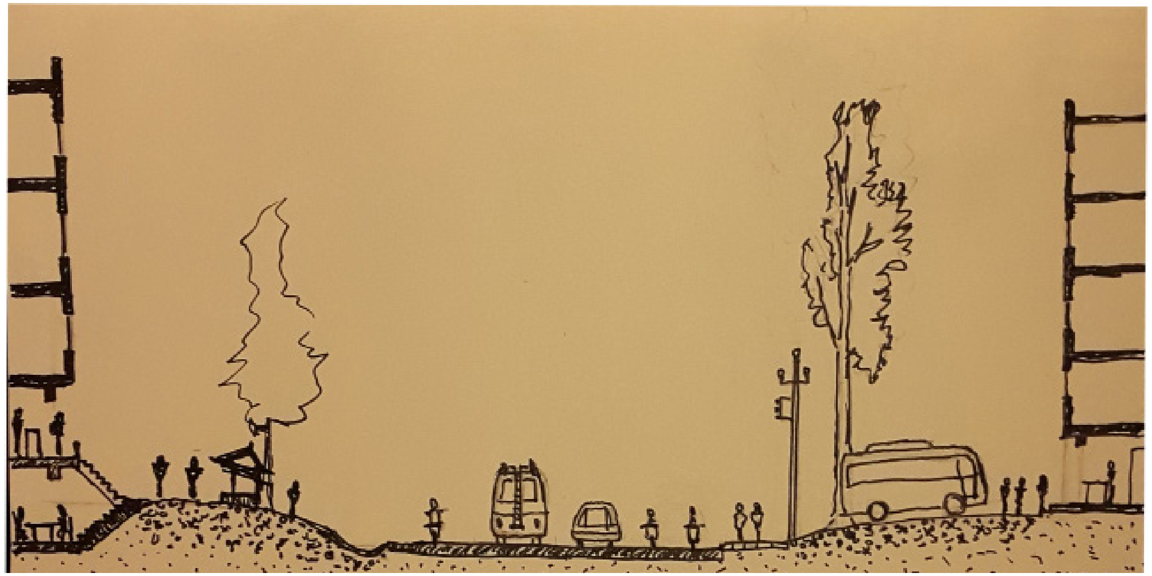




appropriateness of sizes: ring road

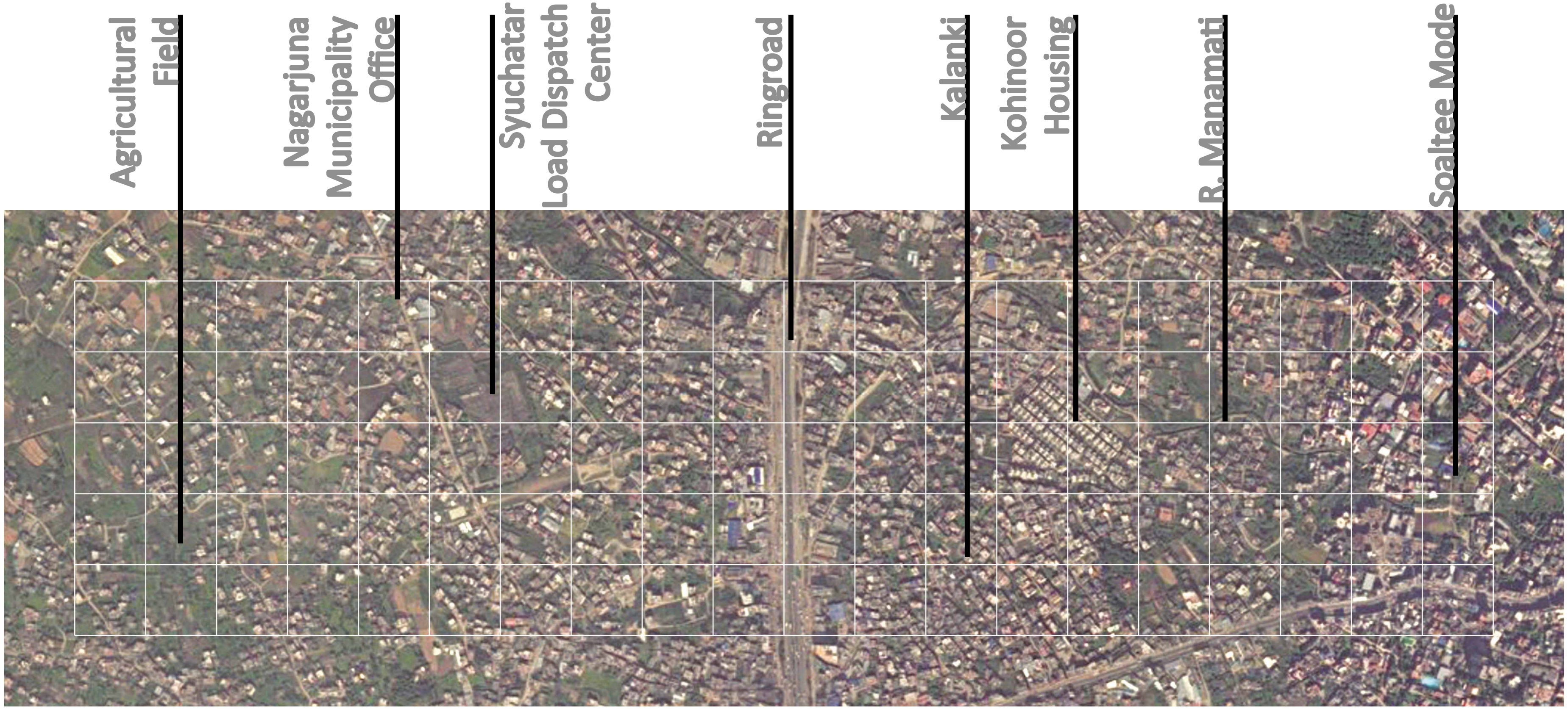






Urban Strip 1 (Field Visit 2016/2/21-22)

Urban spatial development has very strong 'lock-in' effects: once urban forms are defined, as cities grow, it is very costly to retrofit. Urban form greatly impacts the energy use, infrastructure cost, and the social and economic resilience of a city.

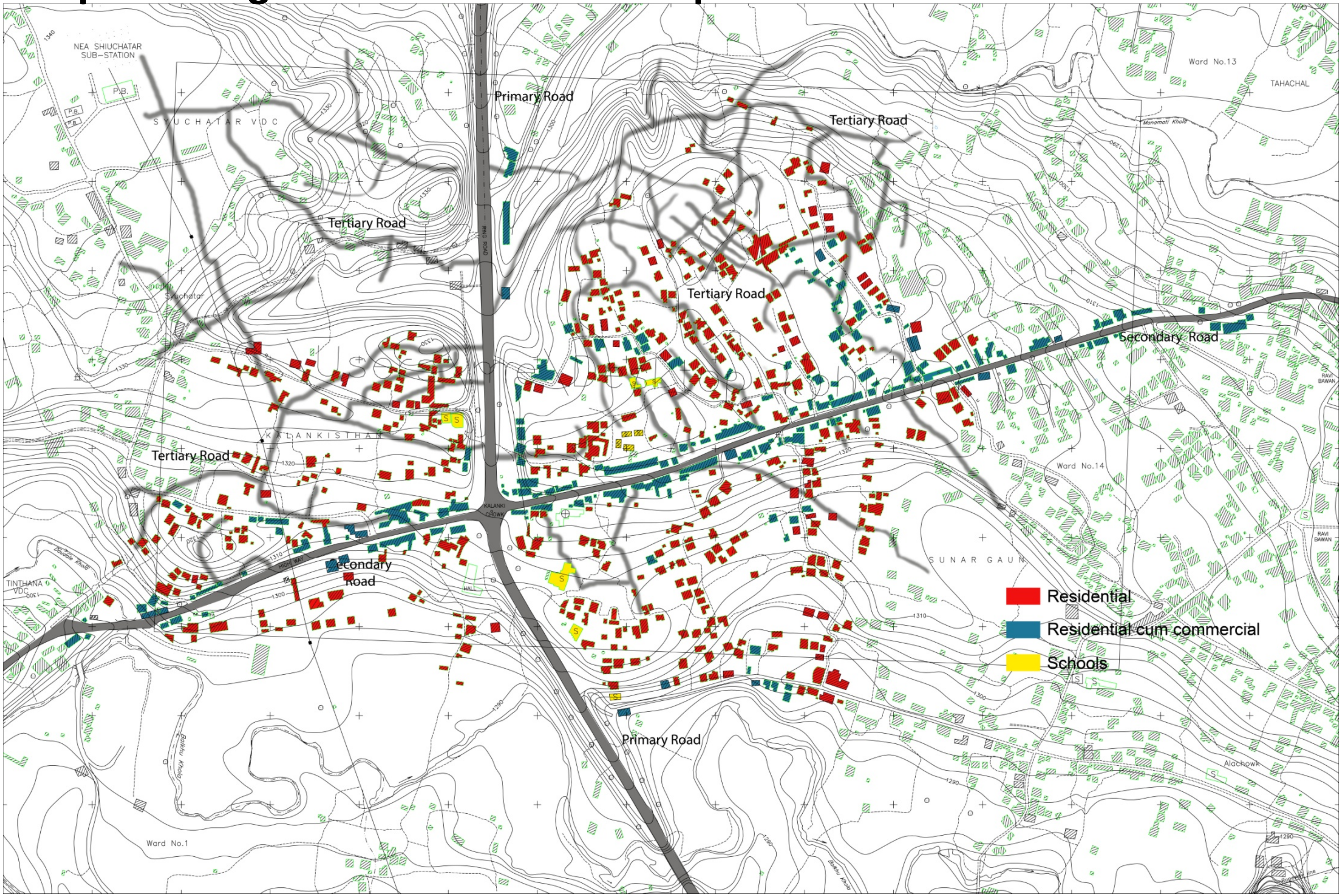


Aerial view of Urban Strip (2 x 0.5 km)

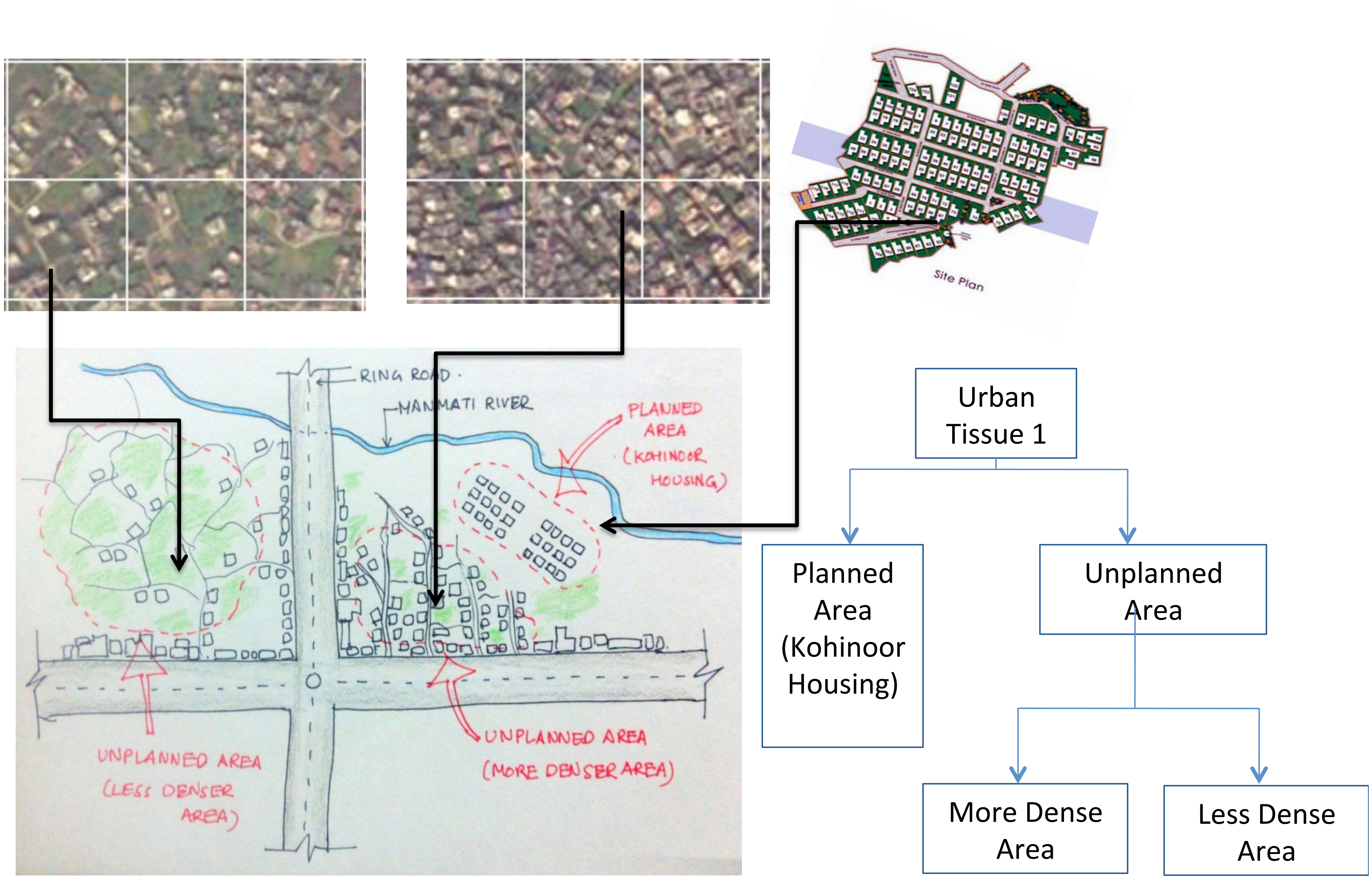
LANDUSE & PLANNING

Zoning: Planning, Density
Bldg use & open spaces

Map Showing The Mixed Use Development

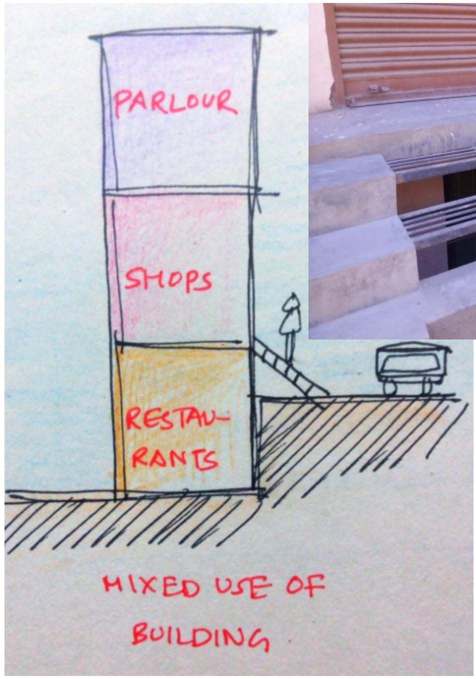


ZONING IN TERMS OF DENSITY

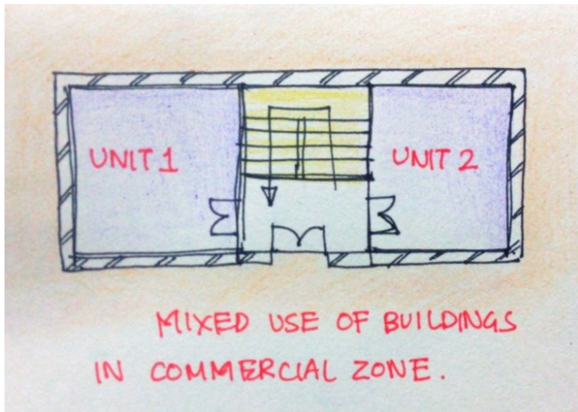


FUNCTIONAL USE

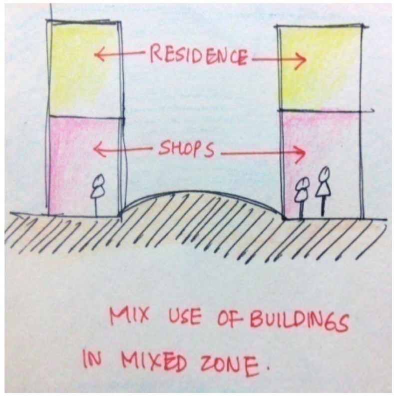
•Commercial Zone



•More than one function in one single buildings.
•One staircase serving two units.

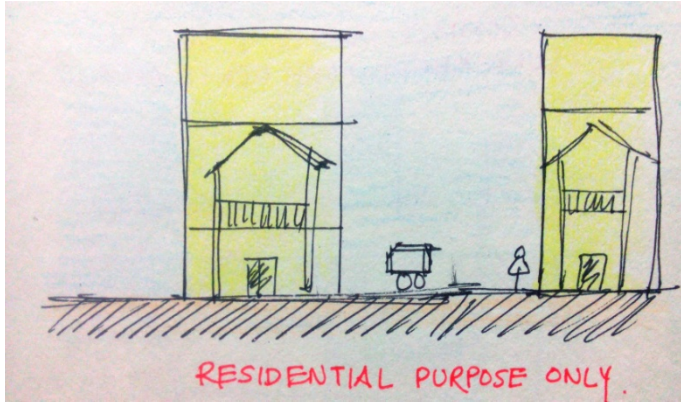


•Mixed Zone



•Shops on ground floor and residence on upper floors.

•Residential Zone

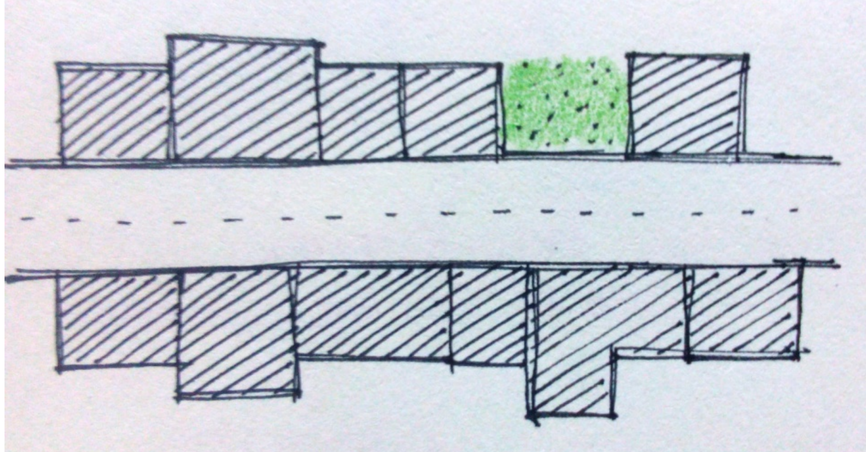


•Only residences in all floors.

OPEN SPACE

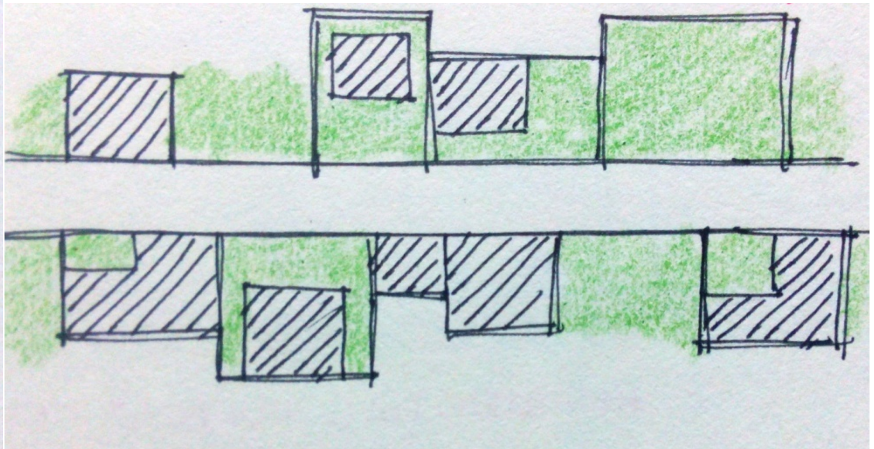
➢On the basis of density

•Unplanned (more dense area)



•Buildings on every plots
•Very less open space left

•Unplanned (less dense areas)



•More open spaces left

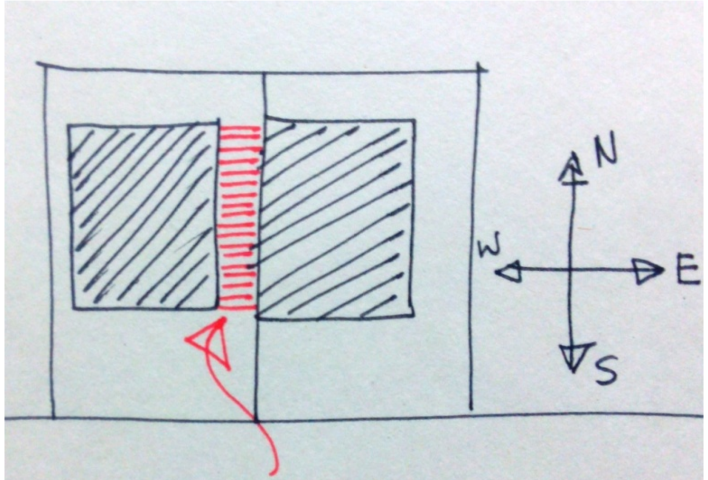
➢In Planned Area and Unplanned Area

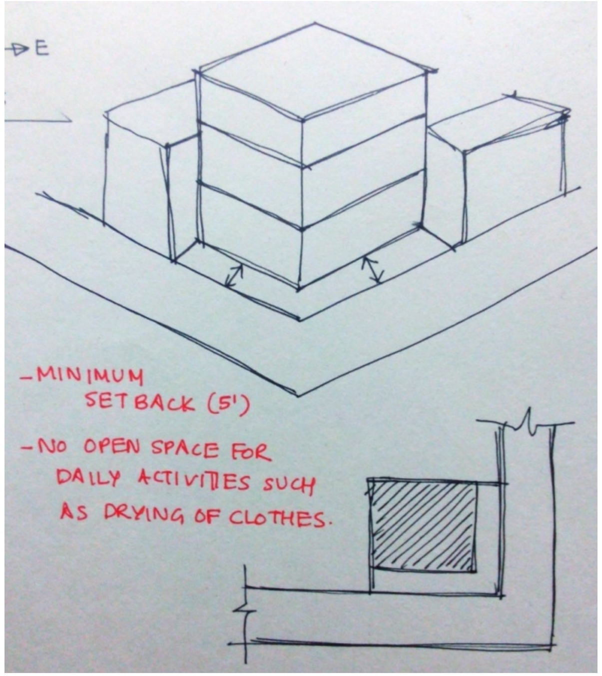
Open space for various activities

Hardly any open space
Open space used for parking

PLANNING ASPECT

Issues in Unplanned Areas





•Nominal setback left.
•No proper ventilation and sunlight.
•No proper space for carrying daily activities eg. Drying of clothes.

RENENEWABLE ENERGY

On site Production, Transimission
Hydro & solar

SOLAR ENERGY :

Unplanned Settlement of **Bafal**

Solar Photovoltaic Panel

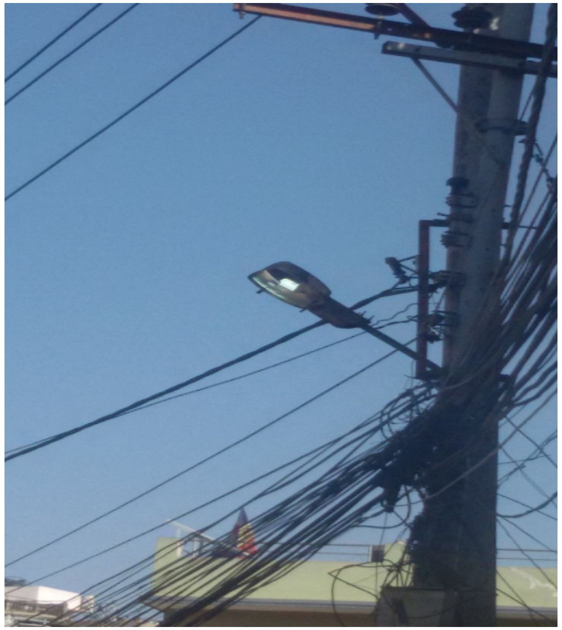
Solar Water Heater
Flat type
Vaccum tube type

Planned Settlement of **Kohinoor Housing**

HYDRO ENERGY :

3 Load Dispatch Center : Syuchatar, Balaju, Hetauda
Establishment Date: Jan 2004

Load Dispatch center, Syuchatar



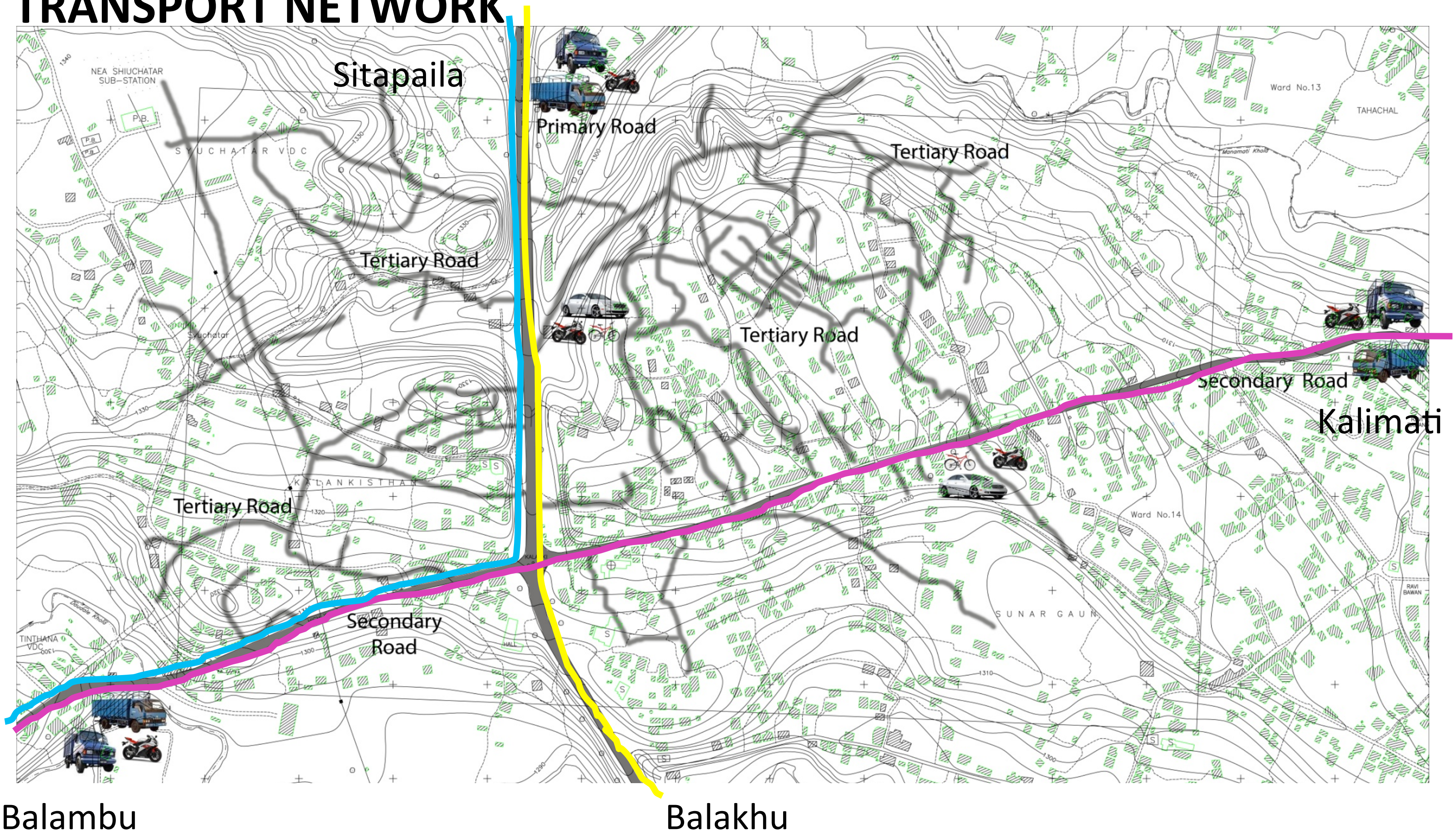
User Behaviour

Poor Distribution Network

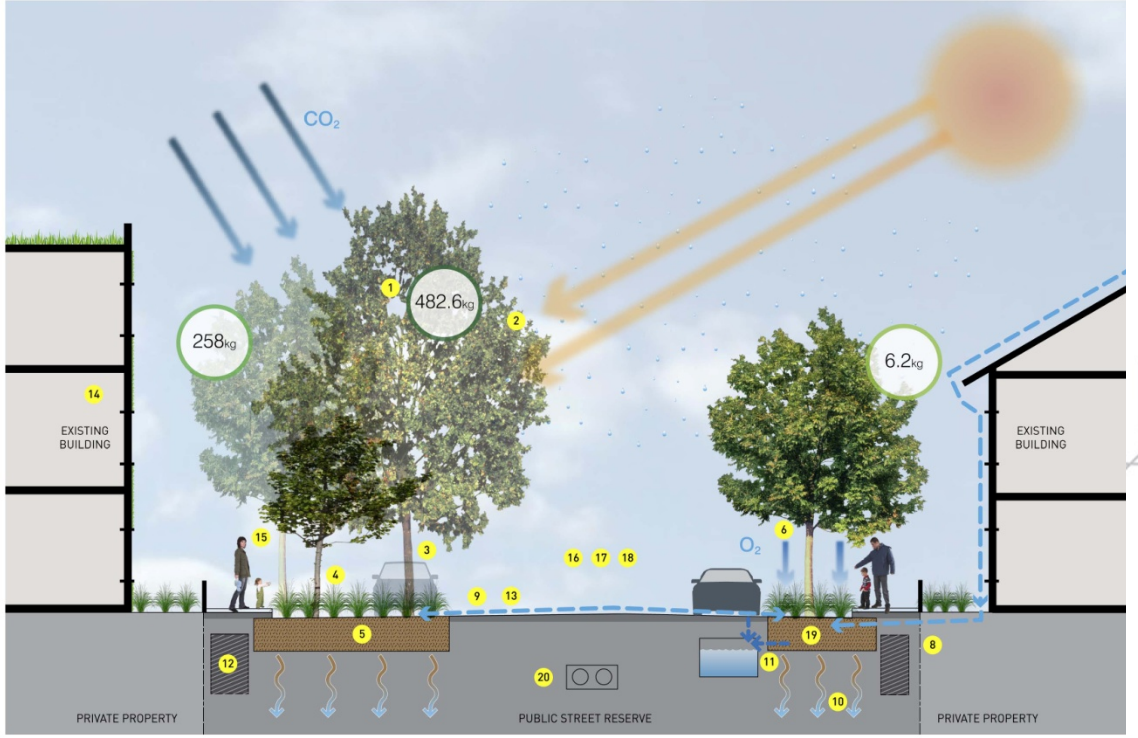
TRANSPORTATION

Public, private & Goods : Vehicle
Inter & Intra valley

TRANSPORT NETWORK

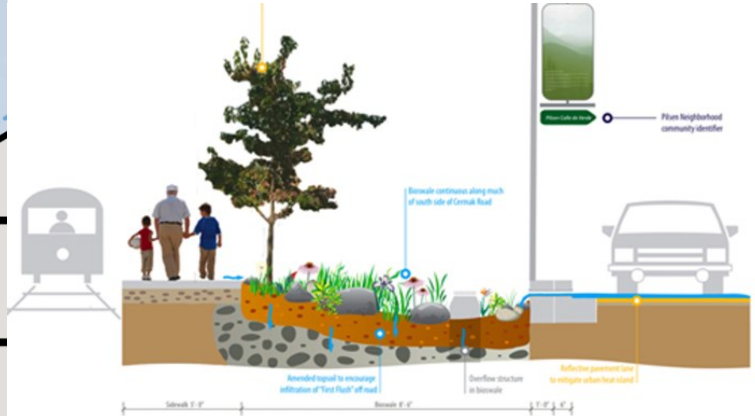


Ganesh Man Singh Road (pink line)	Thankot - Kalimati
Ring Road (yellow line)	Ktm - Lalitpur
Highway (blue line)	Ktm valley to outside valley

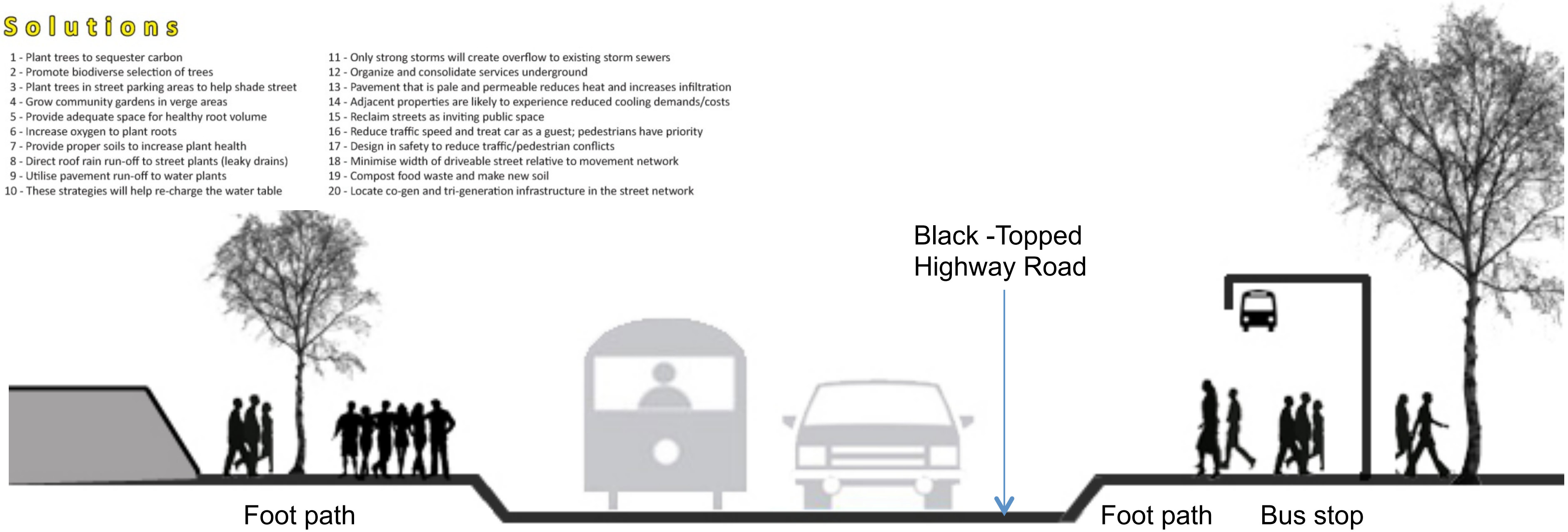


Solutions

1 - Plant trees to sequester carbon
2 - Promote biodiverse selection of trees
3 - Plant trees in street parking areas to help shade street
4 - Grow community gardens in verge areas
5 - Provide adequate space for healthy root volume
6 - Increase oxygen to plant roots
7 - Provide proper soils to increase plant health
8 - Direct roof rain run-off to street plants (leaky drains)
9 - Utilise pavement run-off to water plants
10 - These strategies will help re-charge the water table
11 - Only strong storms will create overflow to existing storm sewers
12 - Organize and consolidate services underground
13 - Pavement that is pale and permeable reduces heat and increases infiltration
14 - Adjacent properties are likely to experience reduced cooling demands/costs
15 - Reclaim streets as inviting public space
16 - Reduce traffic speed and treat car as a guest; pedestrians have priority
17 - Design in safety to reduce traffic/pedestrian conflicts
18 - Minimise width of driveable street relative to movement network
19 - Compost food waste and make new soil
20 - Locate co-gen and tri-generation infrastructure in the street network



Sustainable Road (Literature)



Section of a Highway Road without the porous pavements and greeneries

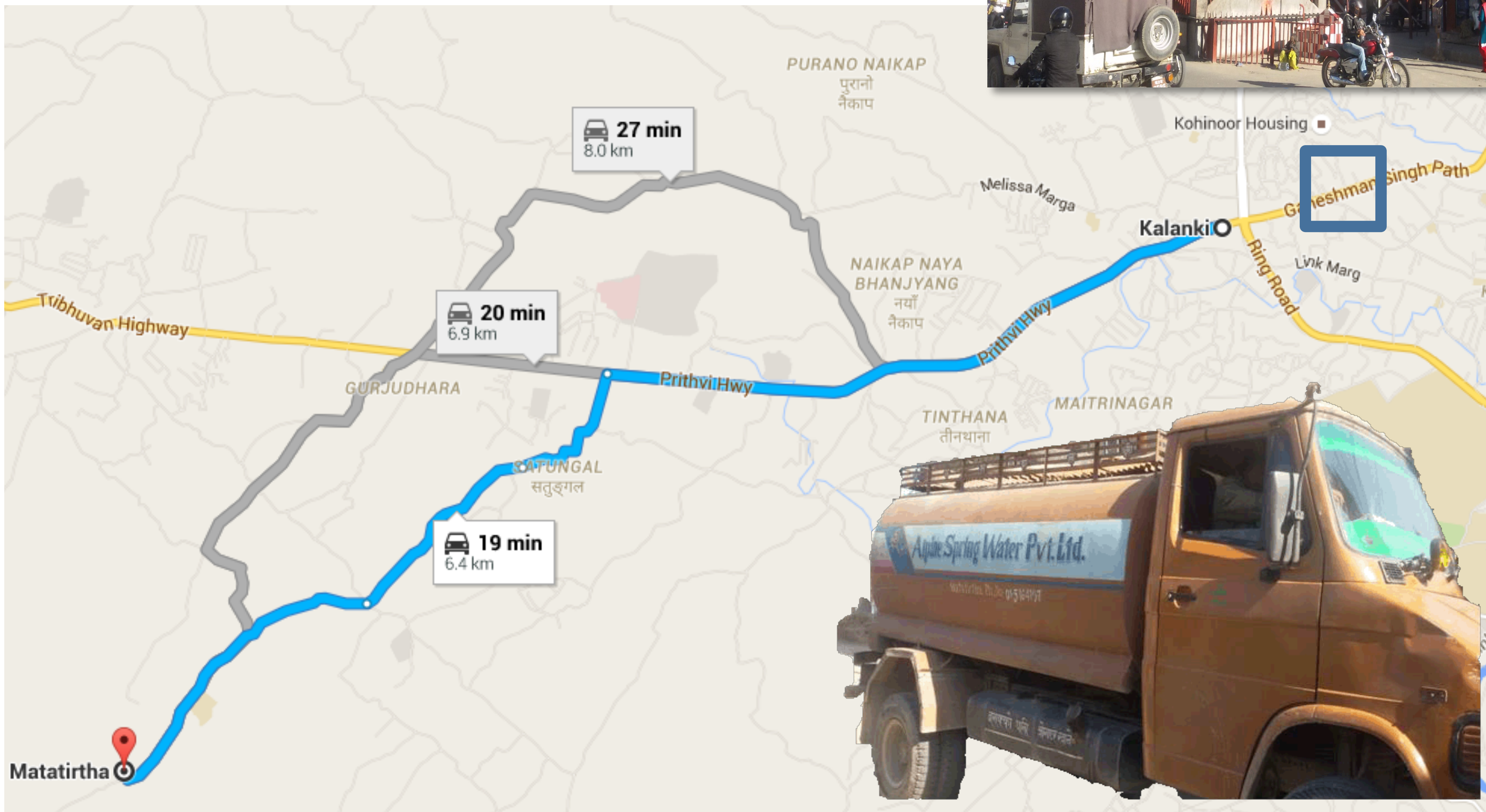
WATER RESOURCES

Traditional & modern water sources

Water supply, Cycle & Recharge

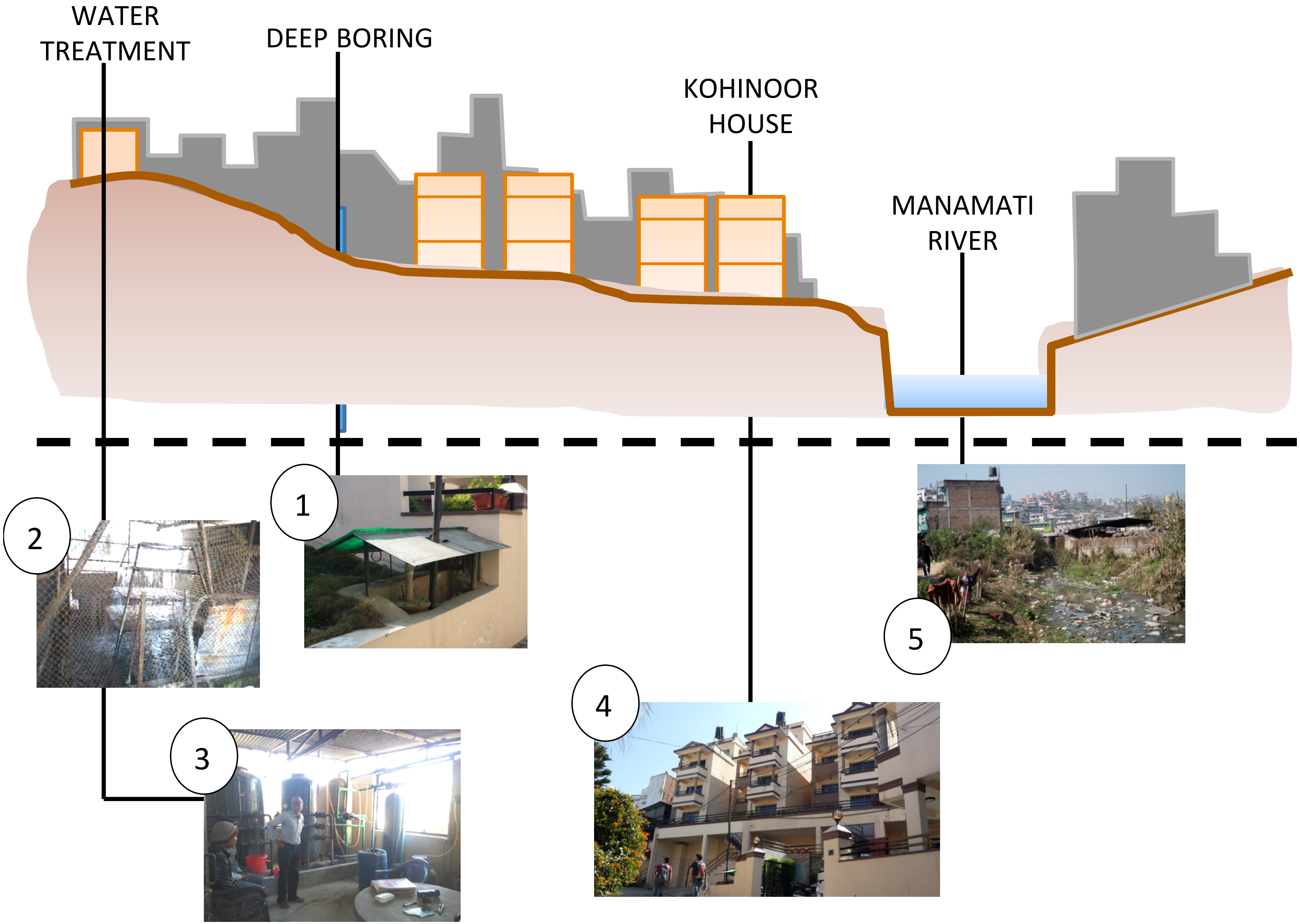
WATER SOURCES

Traditional



Existing Water Supply

WATER SUPPLY SYSTEM inside planned settlement (Kohinoor Hill Housing)



Nagarjuna Municipality

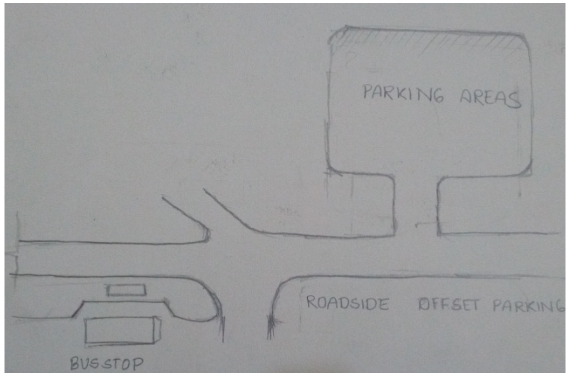
RECHARGING GROUND WATER

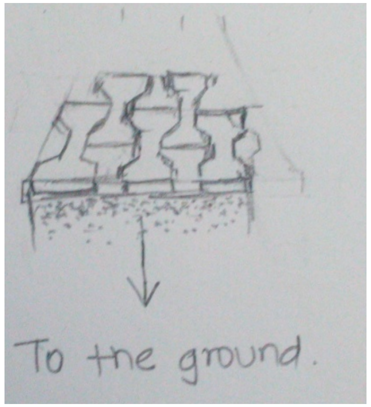
Kathmandu Metropolitan City

Well

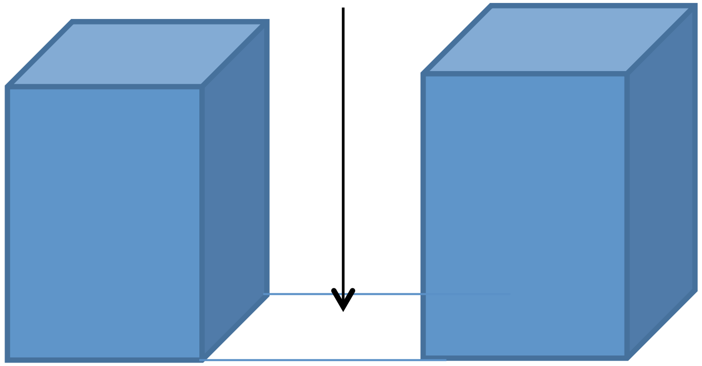
Agricultural Field

Open Ground





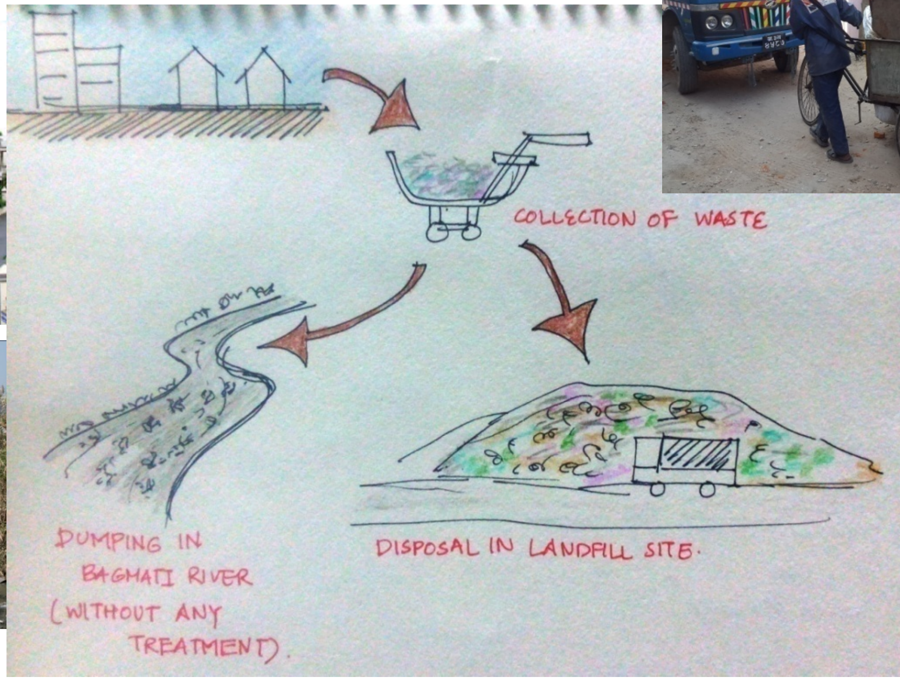
Abandoned land inbetween residences



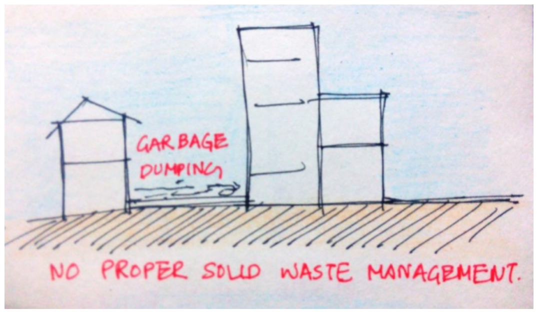
SOLID WASTE MANAGEMENT

Present practices, Problems
Chances of Composting

SOLID WASTE MANAGEMENT



Unmanaged Solid waste management



- Dumping on the open spaces adjacent to the residences

SOLID WASTE MANAGEMENT
COMPOSTING

YOUNG INITIATIVES

IT Technology

SIREN SYSTEM

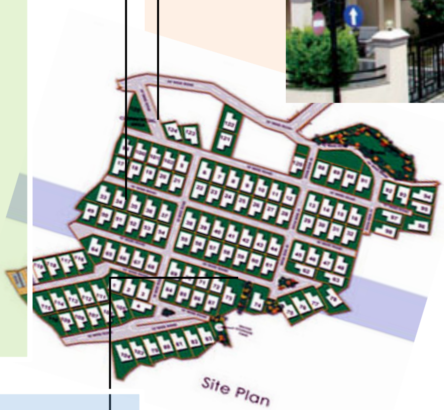
Kohinoor Hills Housing

Use of sirens

Incase of disasters

Local economy and Sustainable transport

- Mostly Businessman
- No local economy
- Required more private vehicles



Ecological protection

- Proposed green space in every plot.
- Water body in the corner of the plot.

Local economy and Sustainable transport

- Shops on the ground floor
- Local economy
- Required less private vehicles

Drinking water

- Source from the deep boring.
- no requirement of water supply from external source.

Ecological protection

- Mainly row houses with maximization of floor area.
- No green space.

Drinking water

- Drinking water supply from the tank.

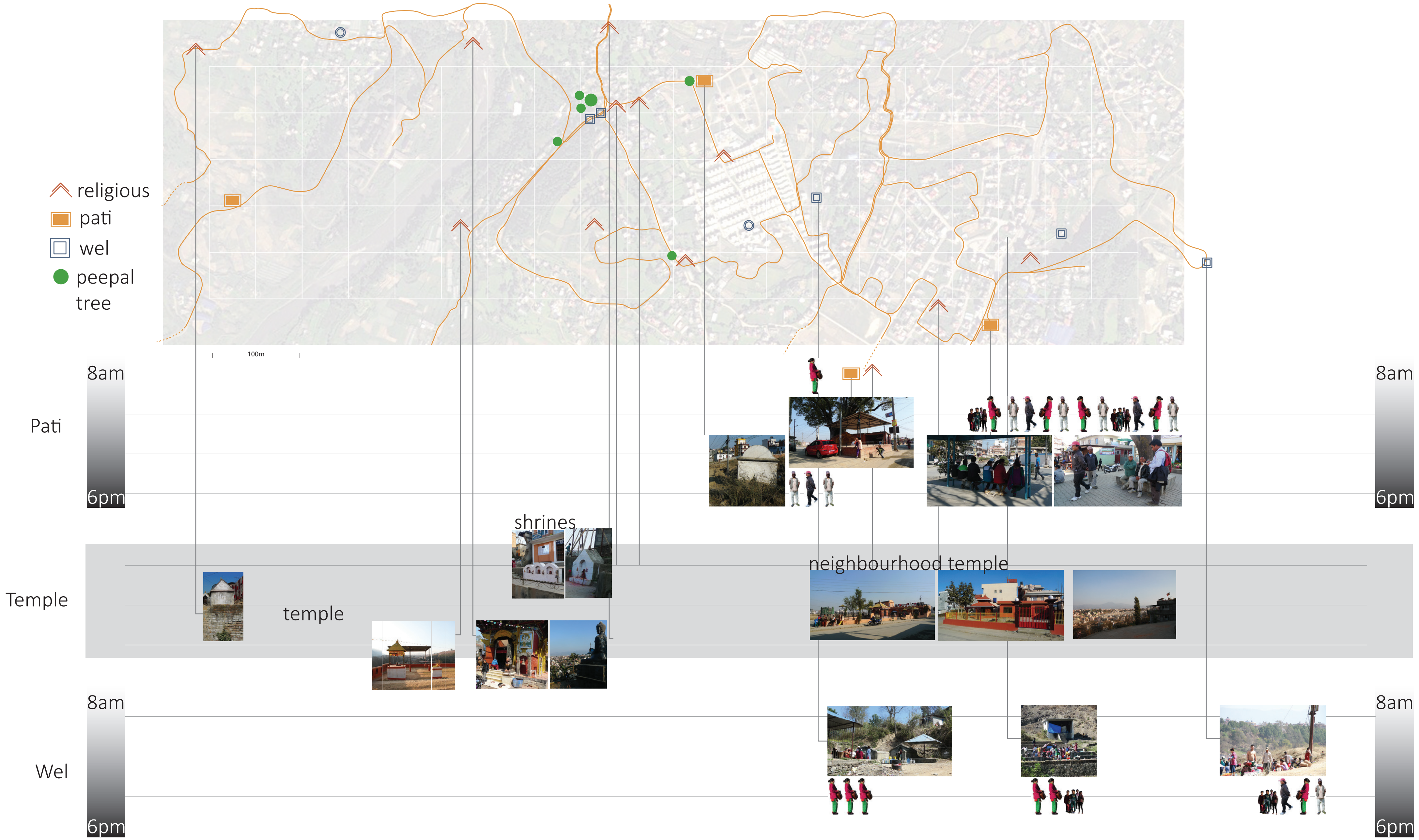
town extensions
fieldwork exercise

STRIP 2
the peri-urban condition

fieldwork walk : a movie

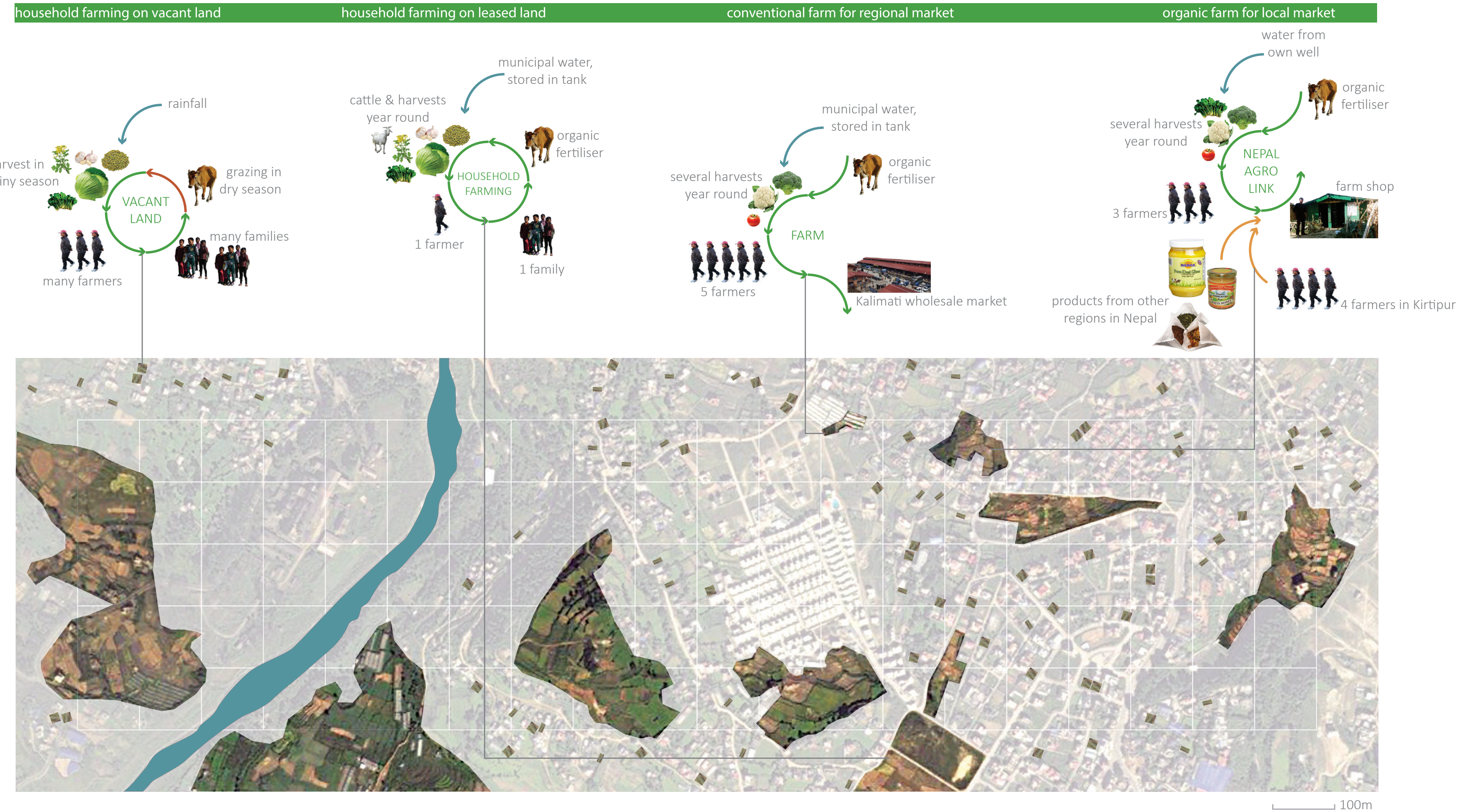
frequencies of appropriation

How are the different spaces used throughout the day and by whom?



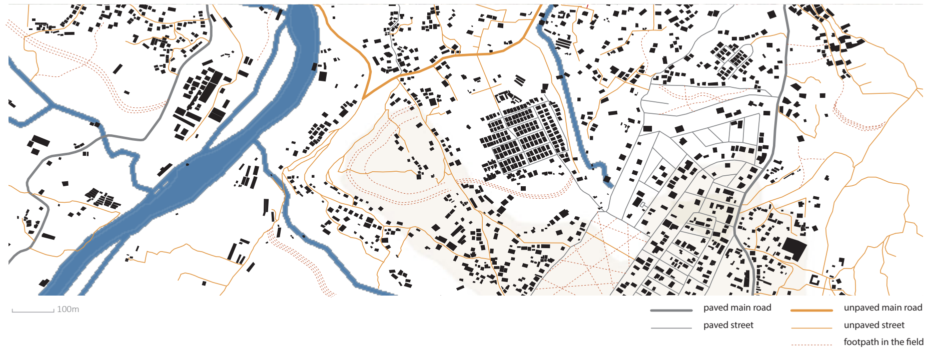
interweaving productivity and urban pressure

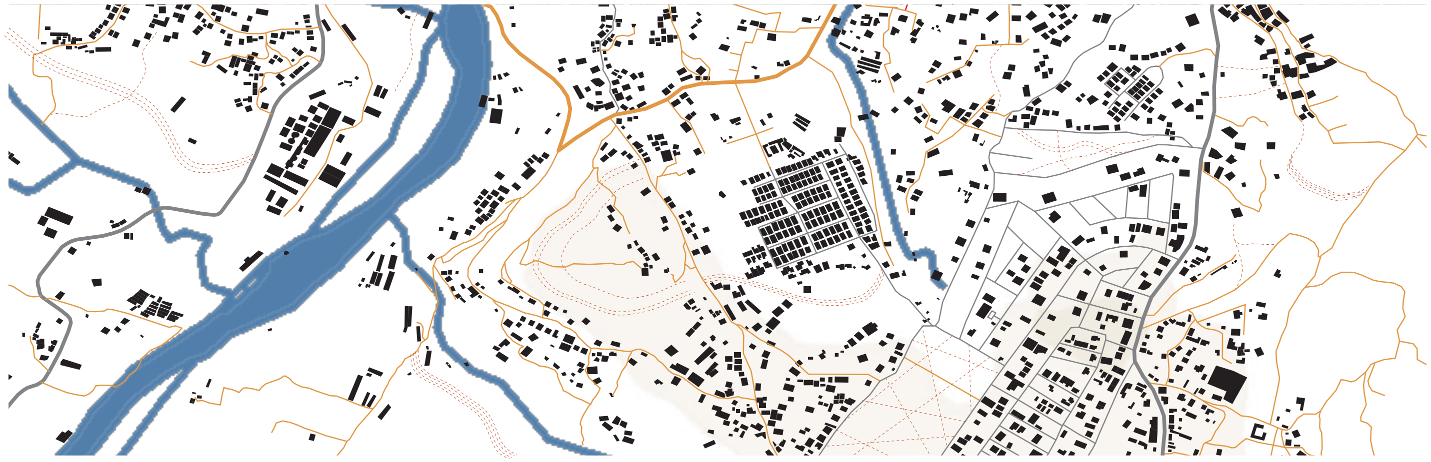
What is the role of a productive landscape in a constantly sprawling urban tissue?



flows

How does urban growth affect on the permeability of the urban fabric?



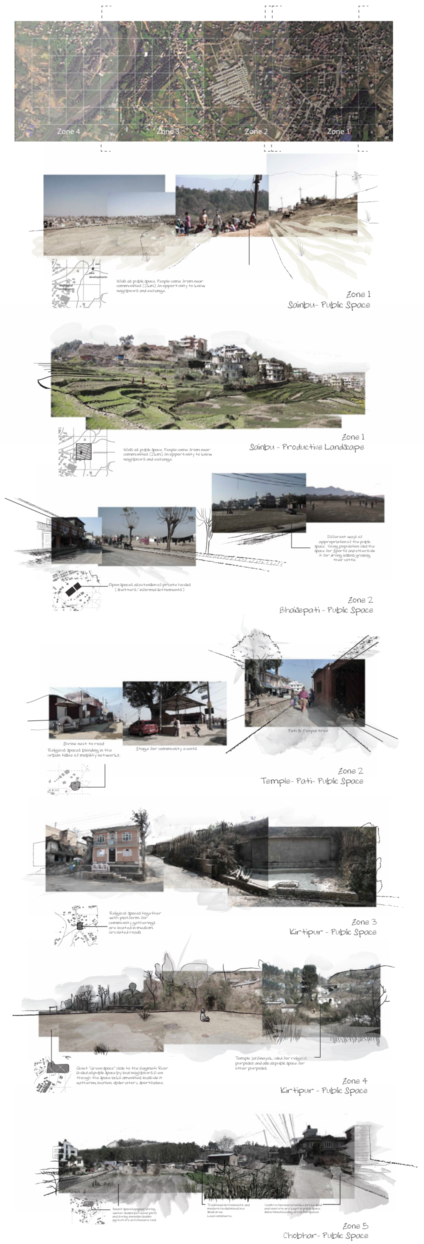


100m

paved main road
paved street
unpaved main road
unpaved street
footpath in the field

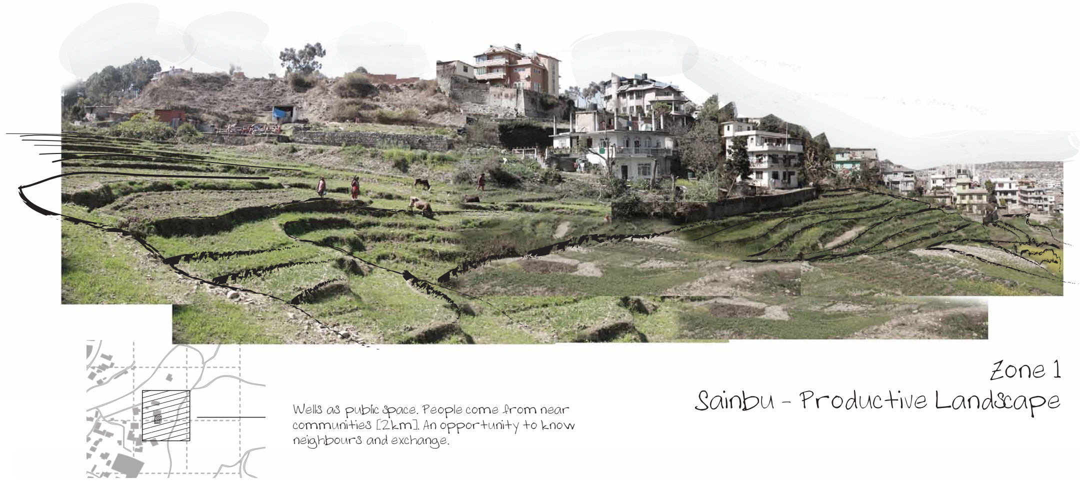
path | unpaved | paved

public spaces



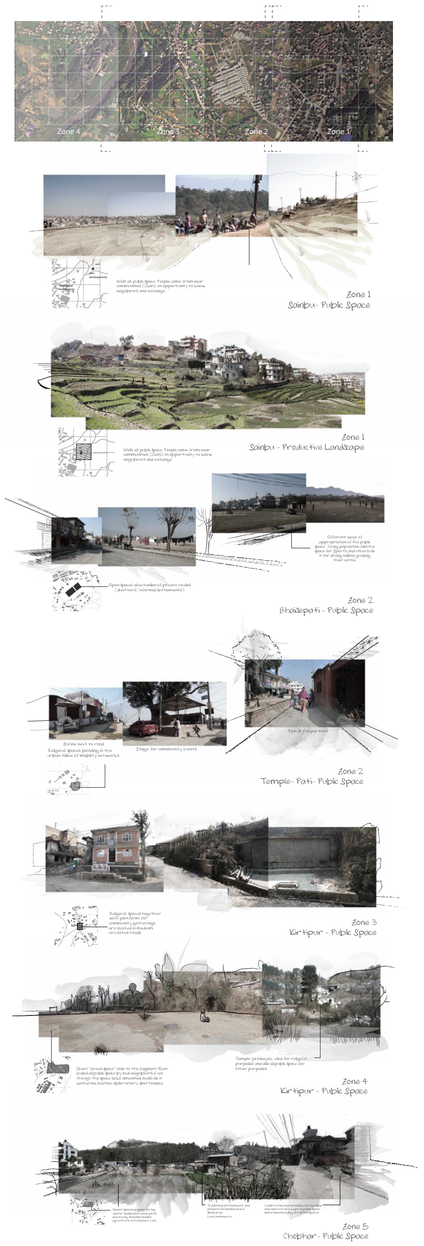
Wells as public space. People come from near communities [2km]. An opportunity to know neighbours and exchange.

Zone 1
Sainbu- Public Space

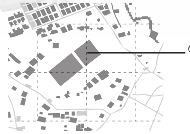


Wells as public space. People come from near communities [2km]. An opportunity to know neighbours and exchange.

Zone 1
Sainbu - Productive Landscape



Different ways of appropriation of the public space. Young population uses the space for sports and others use it for driving lessons grazing their cattle.



Open spaces as extension of private houses [shelters / informal settlements]

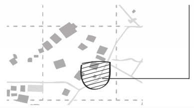
Zone 2
Bhaisepati - Public Space

Shrine next to road

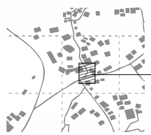
Religious spaces blending in the urban tissue of mobility networks.

Stage for community events

Pati & Peepal tree

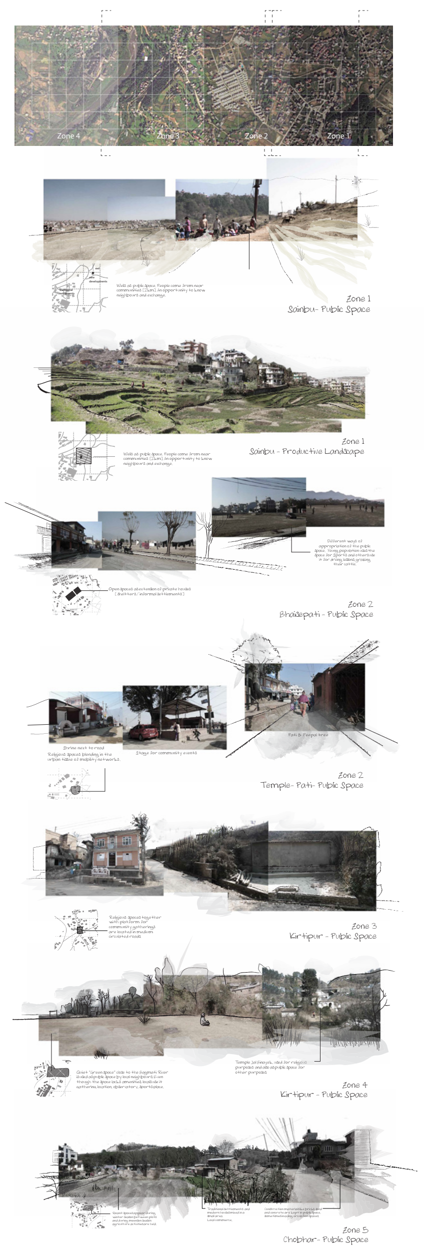


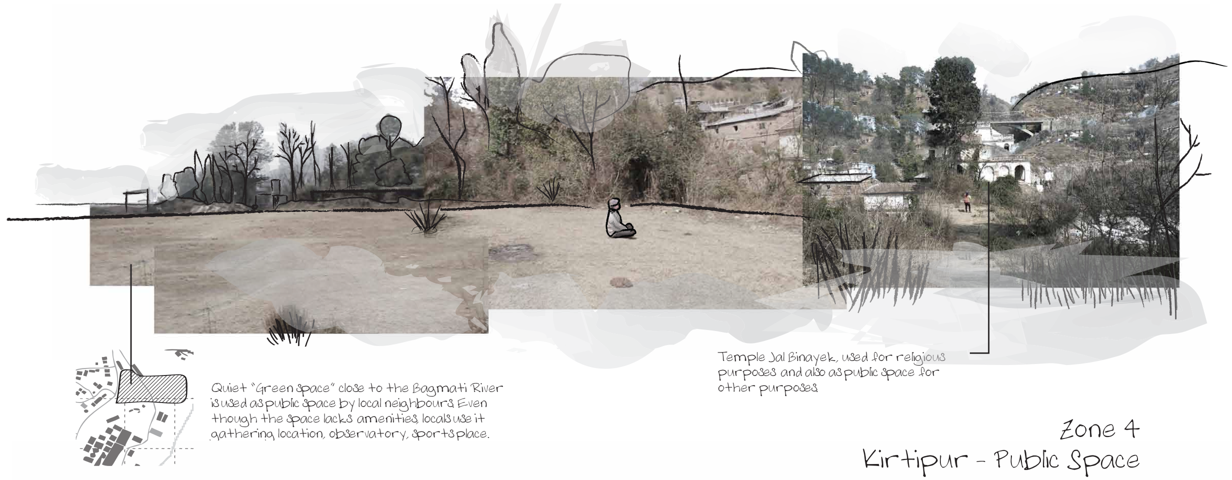
Zone 2
Temple- Pati- Public Space



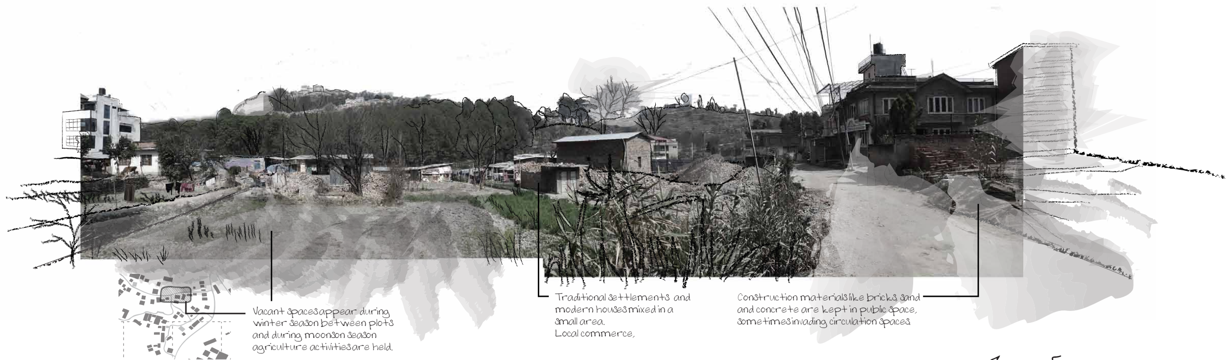
Religious spaces together with platform for community gatherings are located in medium circulated roads

Zone 3
Kirtipur - Public Space





Zone 4
Kirtipur - Public Space



Zone 5
Chobhar- Public Space

Energy Sources:

- Traditional form of energy
  - Biomass; Timber, Cow dung cake
  - Primitive energy source.
  - Capitalizing on bi-product of cattle rearing
  - Staking of timber for drying common in rural fringe

Source: Wikimedia Commons

Source: Myscoopwhoop

Drying of timber (to left) and cow dung cake (above); used for making fire.

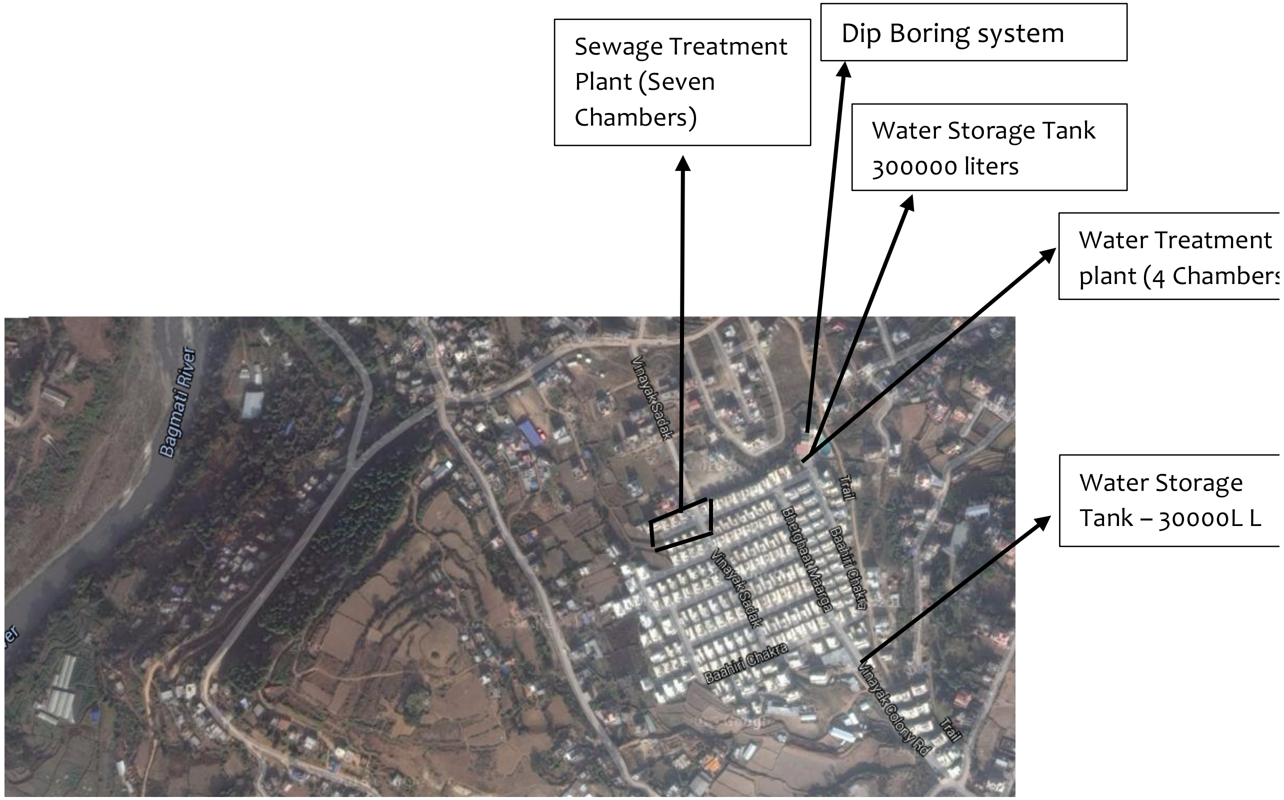
Contemporary energy forms:

- Electricity; Distributed from grid
- Cooking gas
- Solar PV panel
- Solar water heater
- Petrol for transportation

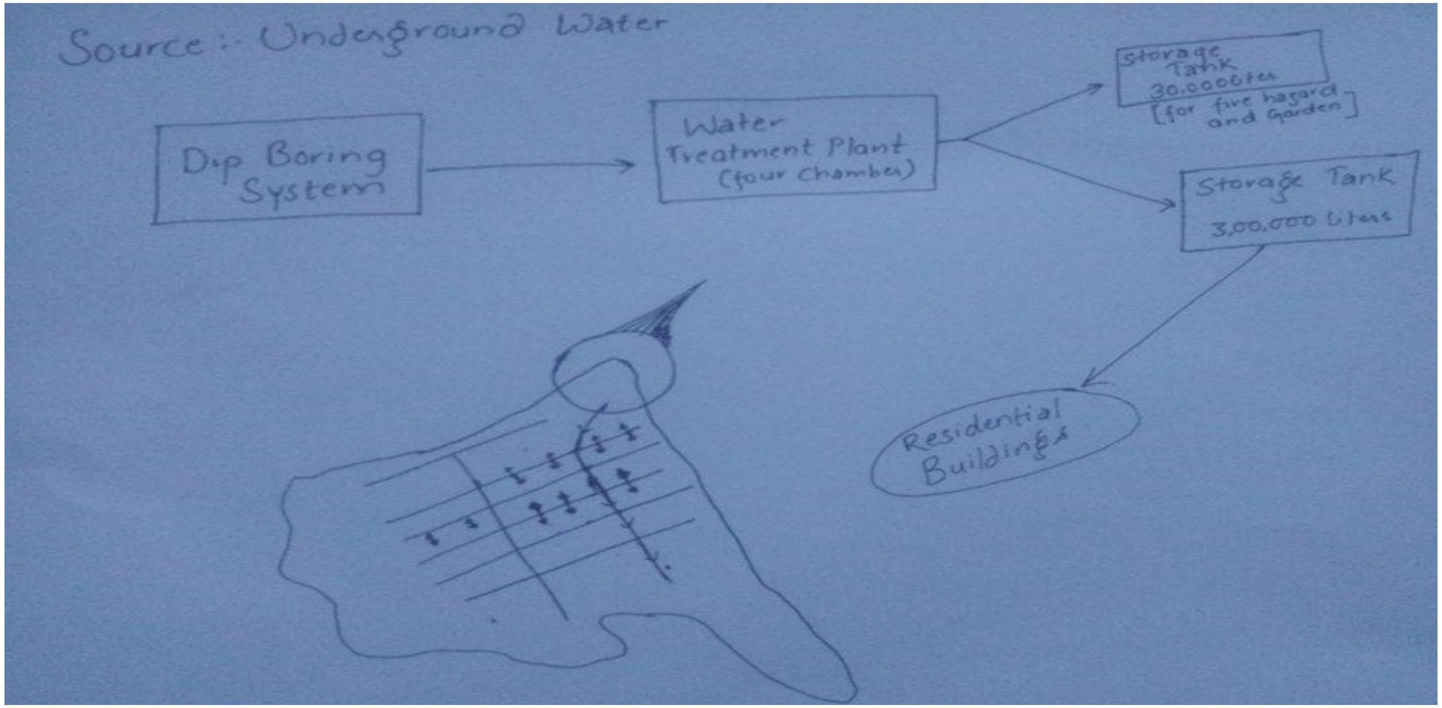
Solar PV panel small scale operation. Stand alone units.

<u>Solid Waste (present context)</u>

- Municipal Hauling System (Twice a week)
- Open Dumping
- Incineration



Water Supply



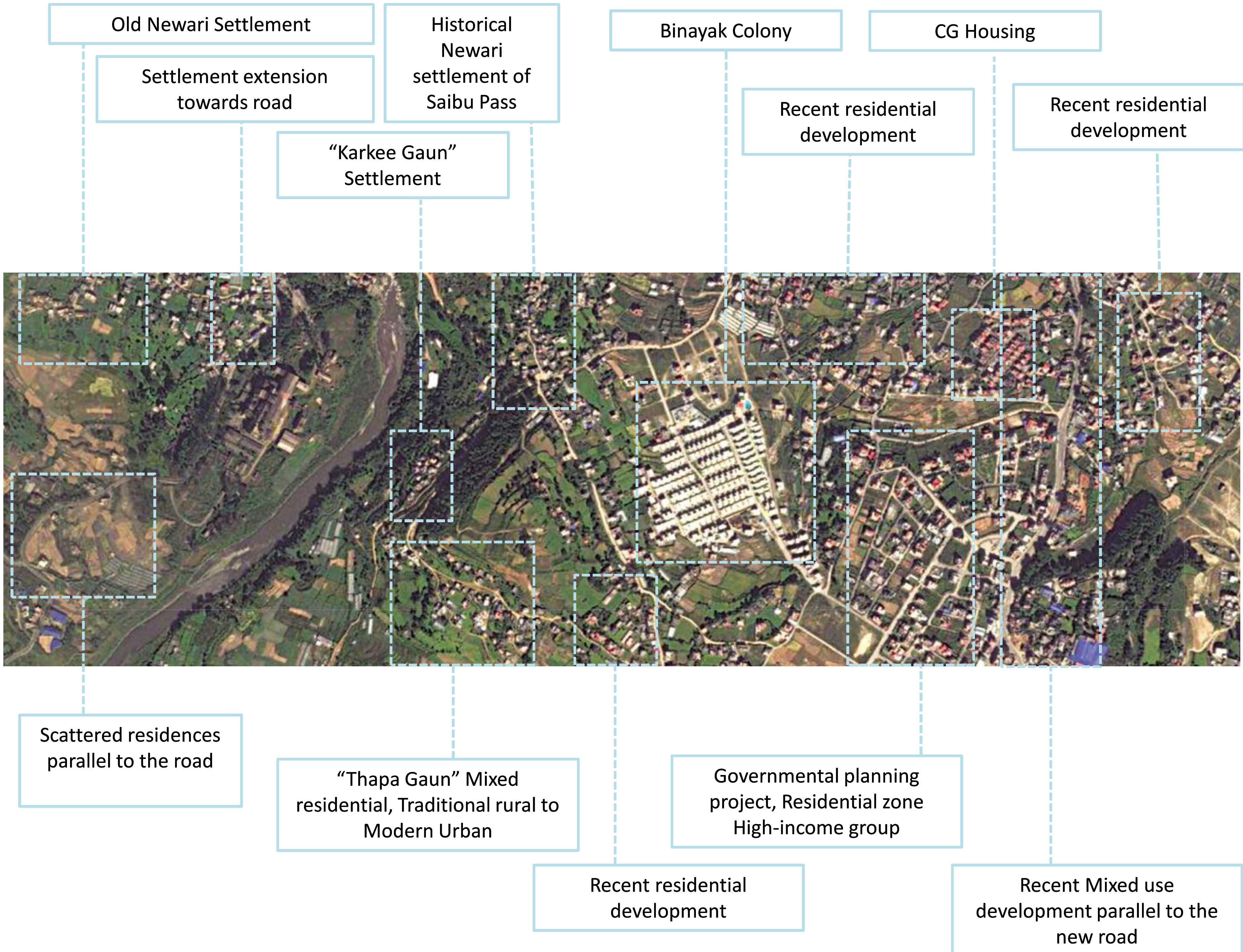
Location of Soil and Waste Manholes

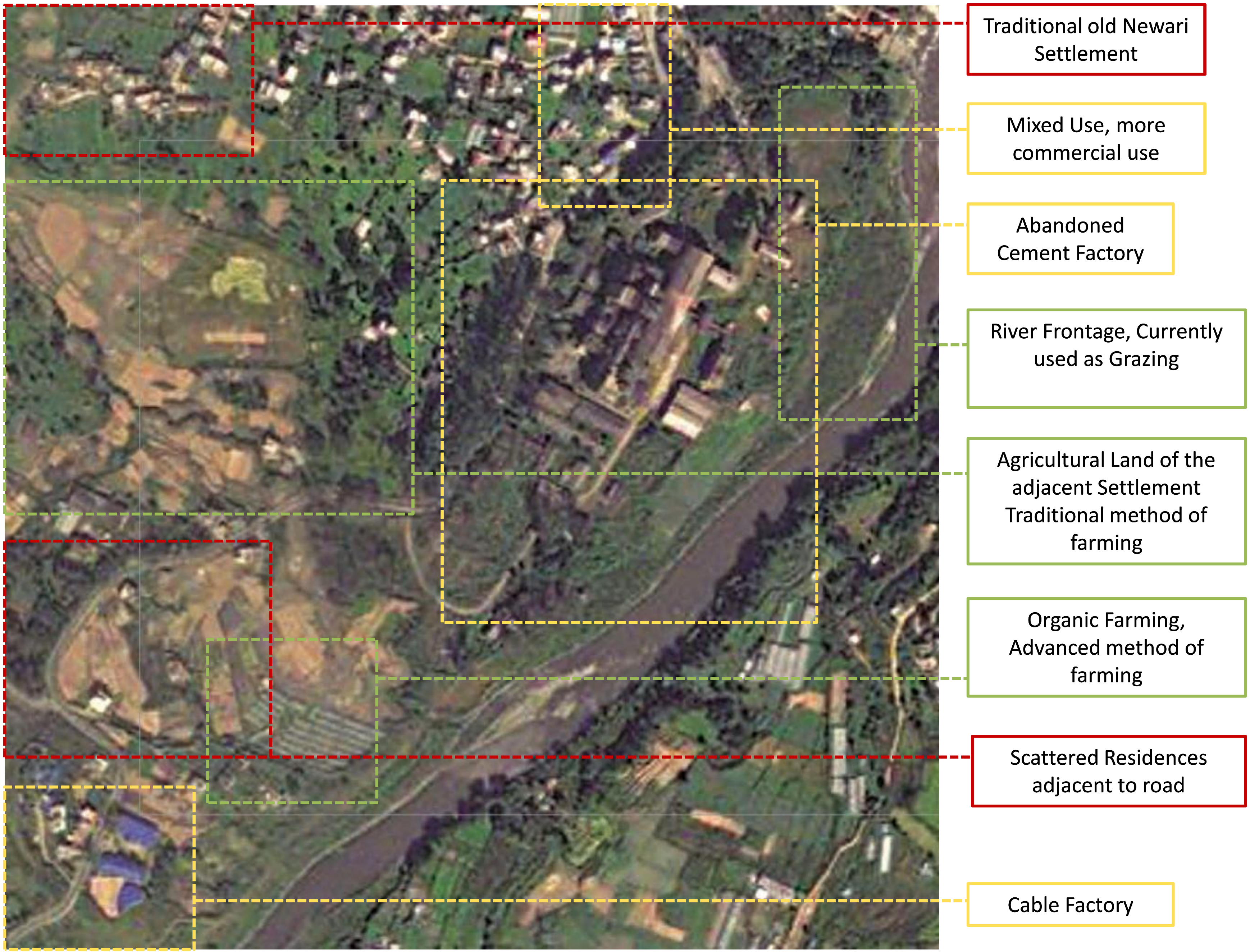
Sewer

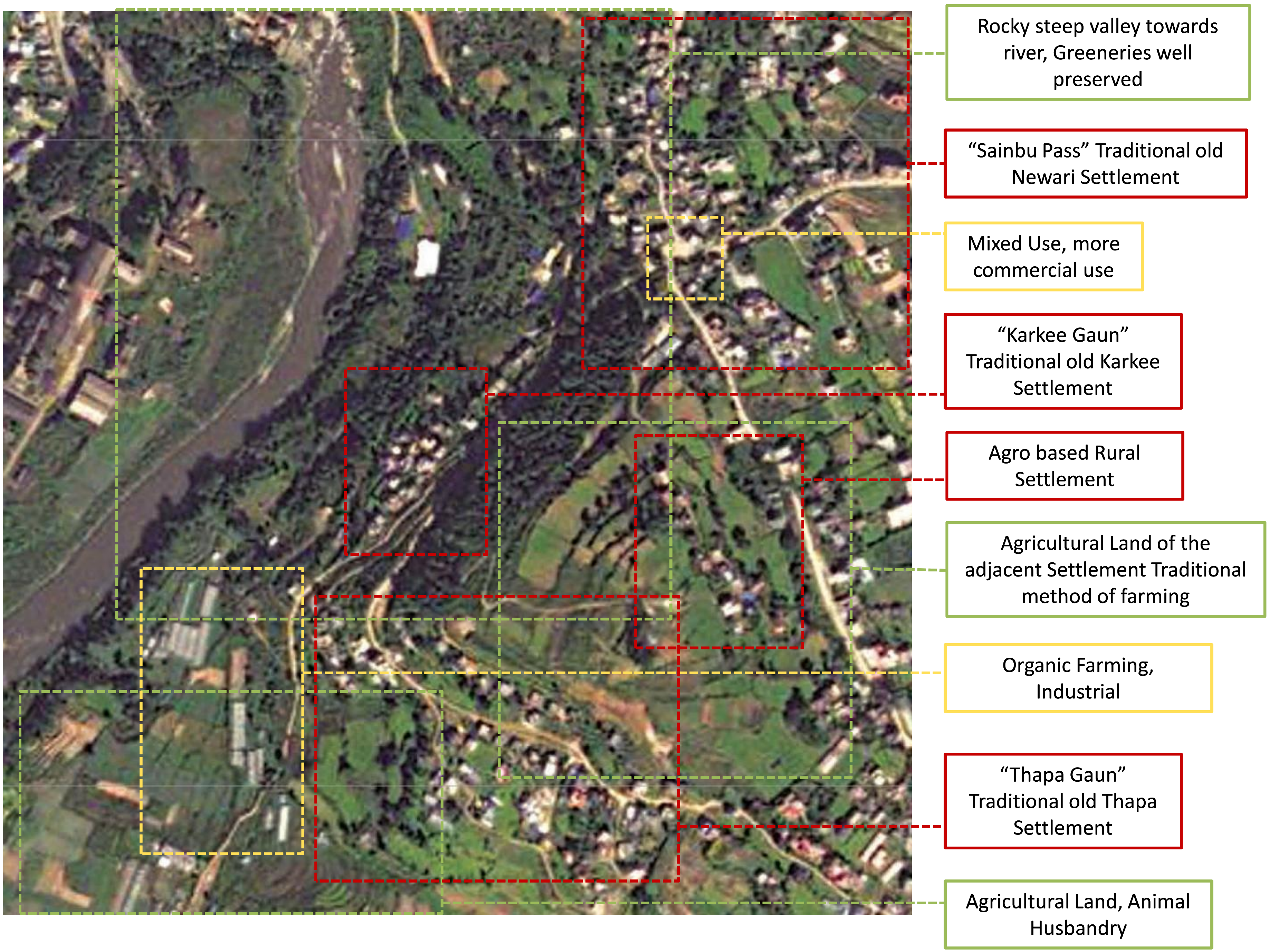
Sewage System at Vinayak Colony

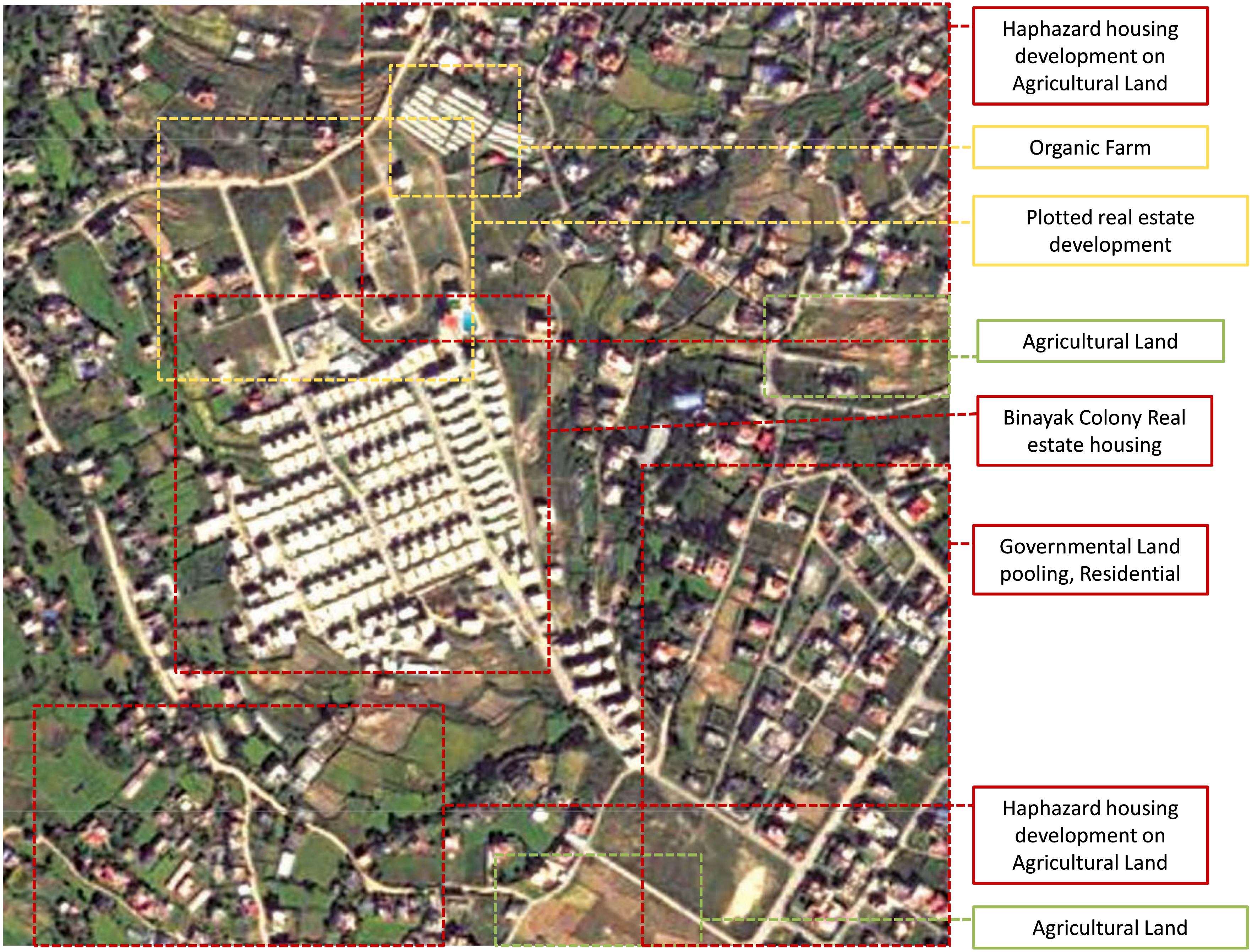
Source of water for premises of Vinayak Colony

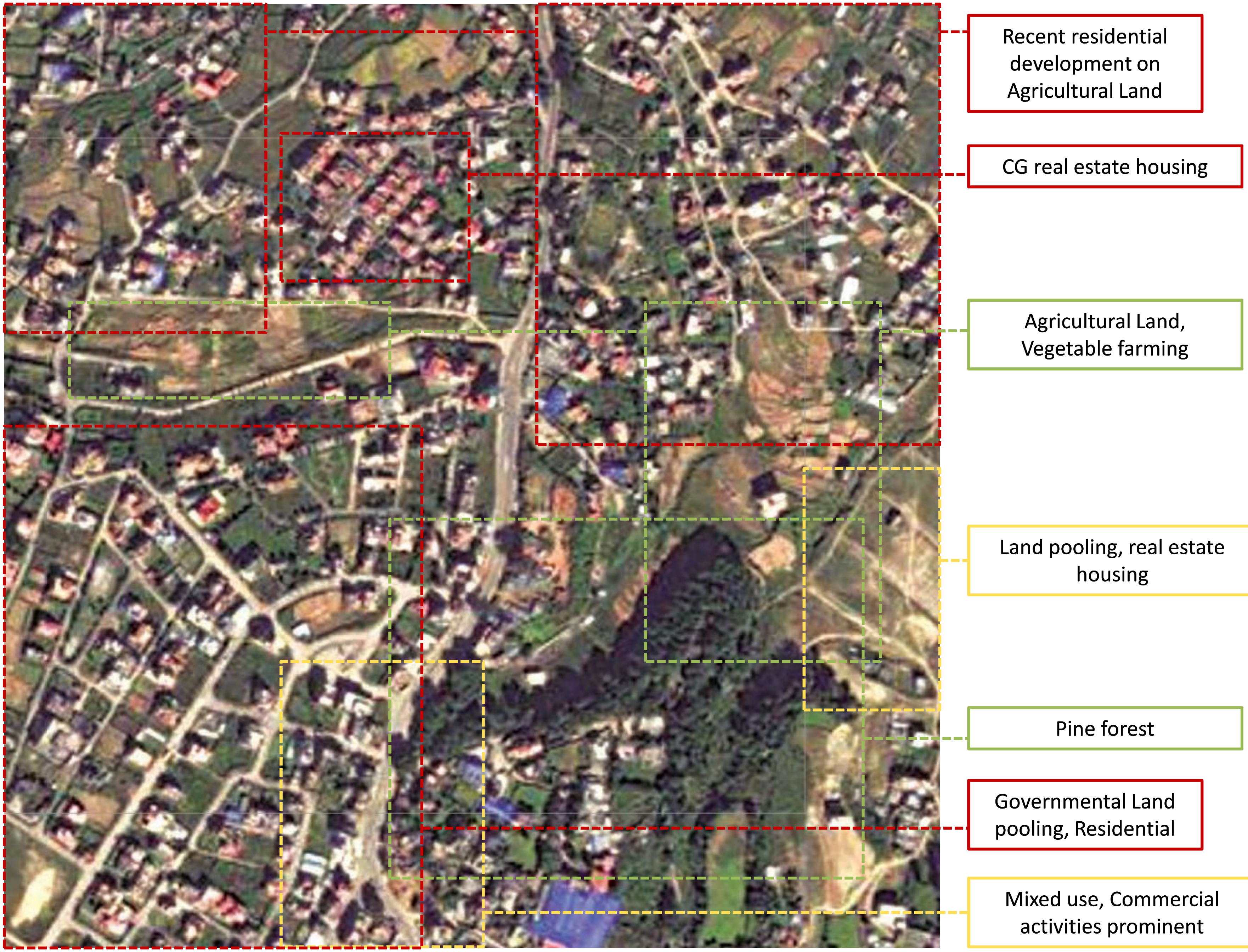
Well


Old Newari Settlement
Settlement extension towards road
Historical Newari settlement of Saibu Pass
"Karkee Gaun" Settlement
Binayak Colony
CG Housing
Recent residential development
Recent residential development
Scattered residences parallel to the road
"Thapa Gaun" Mixed residential, Traditional rural to Modern Urban
Governmental planning project, Residential zone High-income group
Recent residential development
Recent Mixed use development parallel to the new road


Traditional old Newari Settlement
Mixed Use, more commercial use
Abandoned Cement Factory
River Frontage, Currently used as Grazing
Agricultural Land of the adjacent Settlement Traditional method of farming
Organic Farming, Advanced method of farming
Scattered Residences adjacent to road
Cable Factory


Rocky steep valley towards river, Greeneries well preserved
"Sainbu Pass" Traditional old Newari Settlement
Mixed Use, more commercial use
"Karkee Gaun" Traditional old Karkee Settlement
Agro based Rural Settlement
Agricultural Land of the adjacent Settlement Traditional method of farming
Organic Farming, Industrial
"Thapa Gaun" Traditional old Thapa Settlement
Agricultural Land, Animal Husbandry

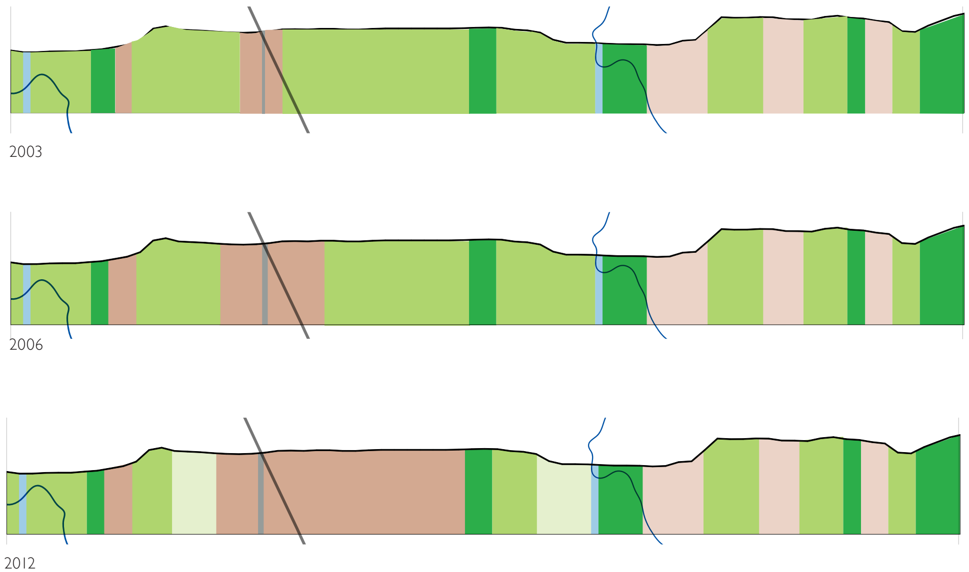

Haphazard housing development on Agricultural Land
Organic Farm
Plotted real estate development
Agricultural Land
Binayak Colony Real estate housing
Governmental Land pooling, Residential
Haphazard housing development on Agricultural Land
Agricultural Land

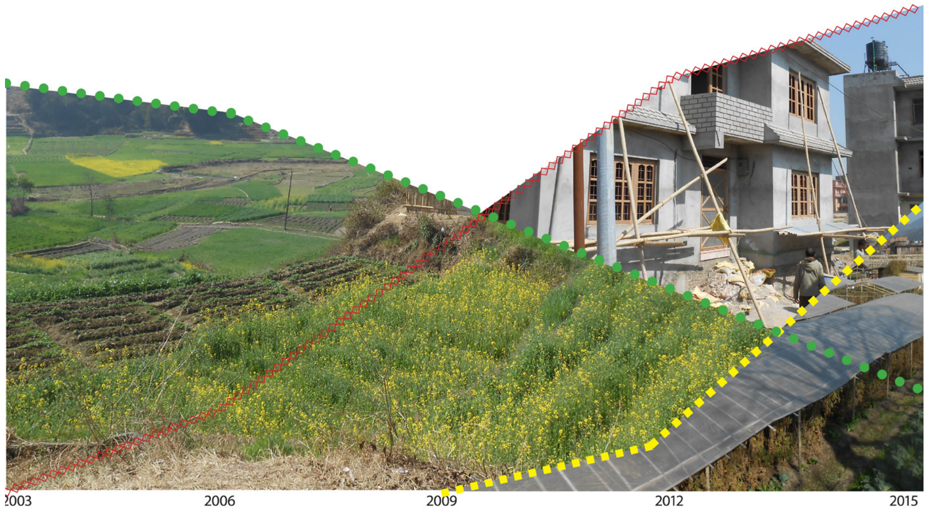

Recent residential development on Agricultural Land
CG real estate housing
Agricultural Land, Vegetable farming
Land pooling, real estate housing
Pine forest
Governmental Land pooling, Residential
Mixed use, Commercial activities prominent

town extensions
fieldwork exercise

STRIP 3
the rural condition

LANDSCAPES IN TRANSITION





HAS TOPOGRAPHY PLAYED A ROLE IN THE URBANISATION SPRAWL IN THAIBA?

RESOURCE BASED PUBLIC SPACES

ARE PERI-URBAN PUBLIC SPACES ORIENTED ON THE BASIS OF THE RESOURCES AVAILABLE?

EDGE CONCEPT within landscapes

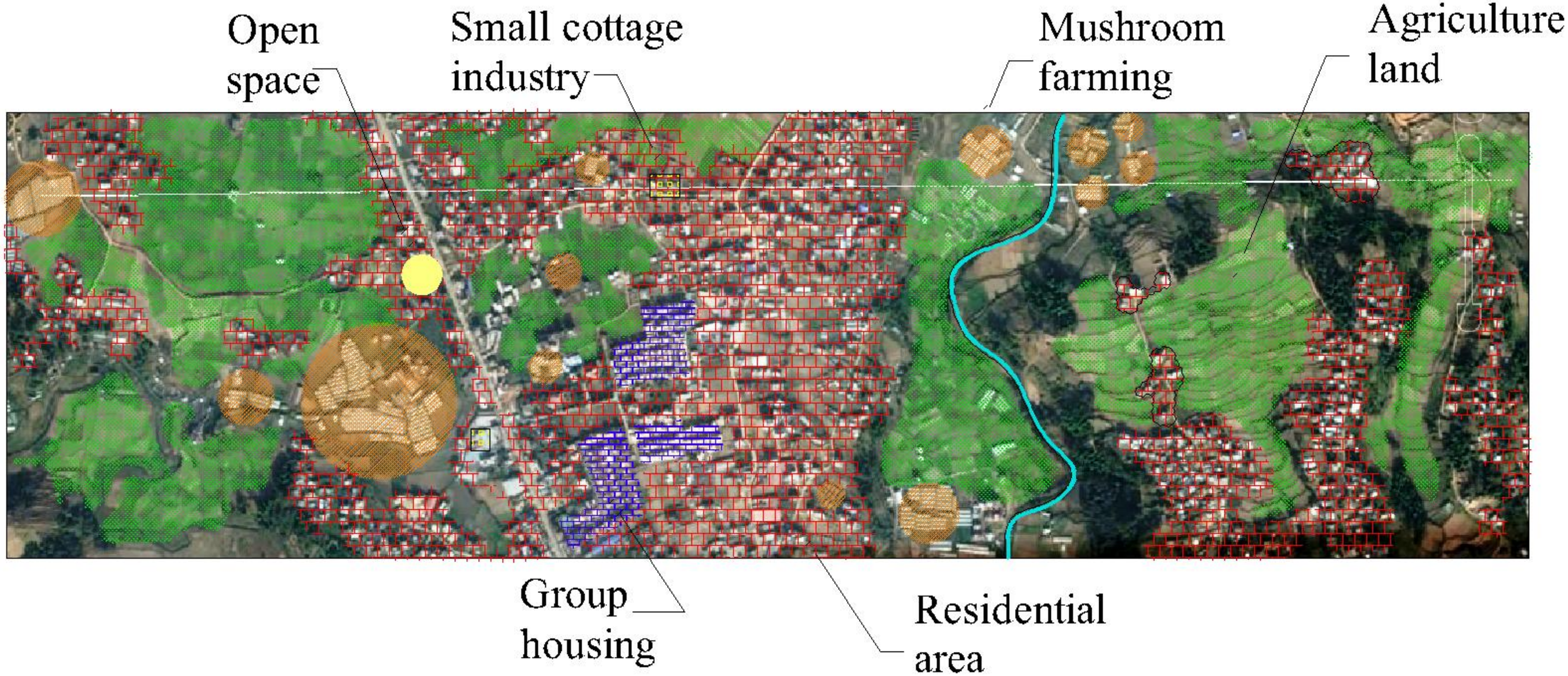
THE CLAIMED EDGE (THE WALLS OF THE NEW DEVELOPMENT)

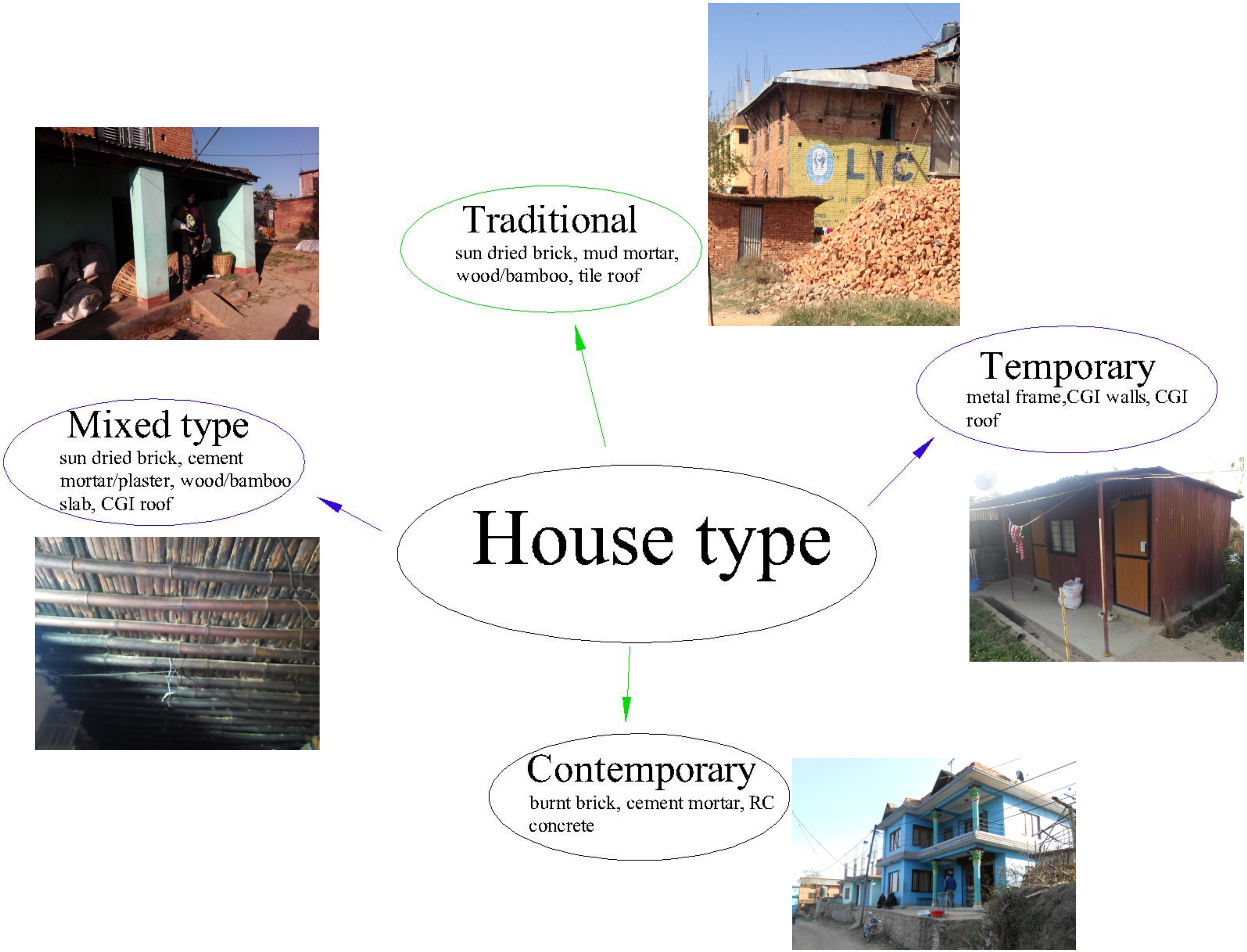
THE TOPOGRAPHICAL EDGE

THE IRRIGATION EDGE

WHAT ARE SOME OF THE EDGE CONDITIONS EXPERIENCED WITH PERI-URBAN AREAS?

LAND USE PATTERN




House type
Traditional
sun dried brick, mud mortar, wood/bamboo, tile roof
Temporary
metal frame,CGI walls, CGI roof
Mixed type
sun dried brick, cement mortar/plaster, wood/bamboo slab, CGI roof
Contemporary
burnt brick, cement mortar, RC concrete

- Mixed use of building materials and construction technology
- Brick and mud mortar is used for wall construction
- Bamboo is used for slab construction, instead of wooden battens and joists.
- Cement plastered walls

- **Contemporary house**
  - RCC Frame Structure
  - Brick and cement mortar used for construction of walls
  - Cement plastered surface

Materials like concrete, mortar or bricks cannot be recycled.
Creates thermal discomfort as compared to traditional house.

- Temporary shelters built of CGI sheet after the massive EQ in the available public space and the private open spaces.
- Creates thermal discomfort.
- Reduces pubic open spaces.

Contemporary house –

- Fusion of RCC structure with traditional style.
- Slope roof with jhingati tiles.
- Thermal comfort due to dachhi appa cladded in the walls and wooden doors/windows.

Rural home

- Brick, mud and wood used as building material.
- Thermal comfort due to heat insulation.
- Open space (yard) in front of house provides space for gathering.
- Cow shed with cattle farming provides cow dung which can be used for biomass production.
- Straw are used to make mat and shoes, which gives employment to women.
- Straw used for mushroom farming.
- Buildings are mostly 2 and half floors which allows penetration of sunlight in the open spaces and the interior spaces.

Unmanaged Drainage along the roadside.

Diety worshipped in stones, without a built structure.

Land Use

- Mixed- Residence, small cottage industries, agriculture land, Farming (Mushroom, Tomato & other vegetables), Livestock (Chicken, Ducks etc.), temples and public amenities

Agricultural

- land along the river bank- easy of irrigation

Residence

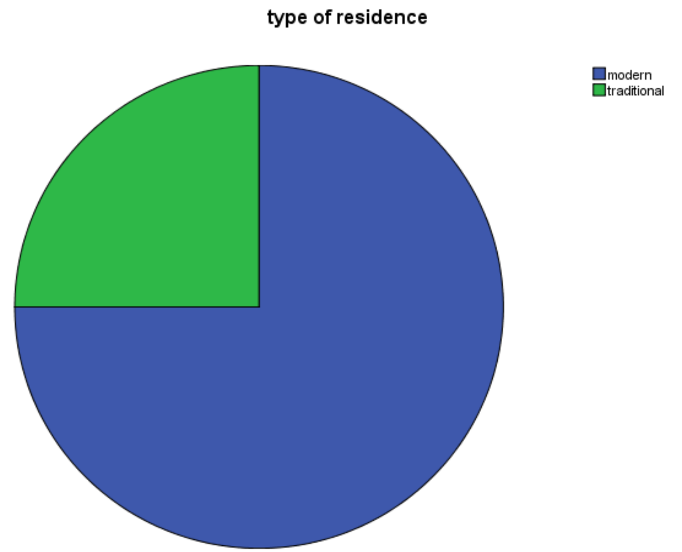
- Scattered settlement - houses expanded to agri-land
- traditional houses- few existed- mostly in the up hills- reserving the fertile agriculture land below
- New houses and Housing project booming up near the road line



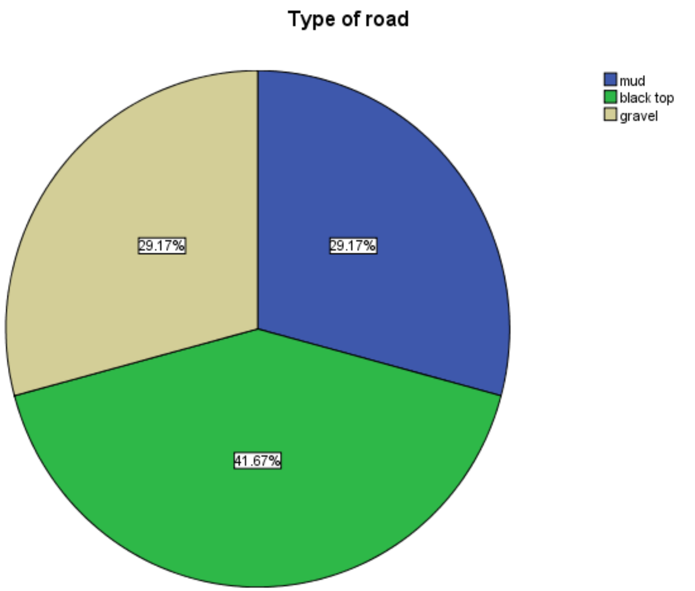
Public Amenities (Social Sustainability)

Public amenities- hiti, public tap- social interaction point

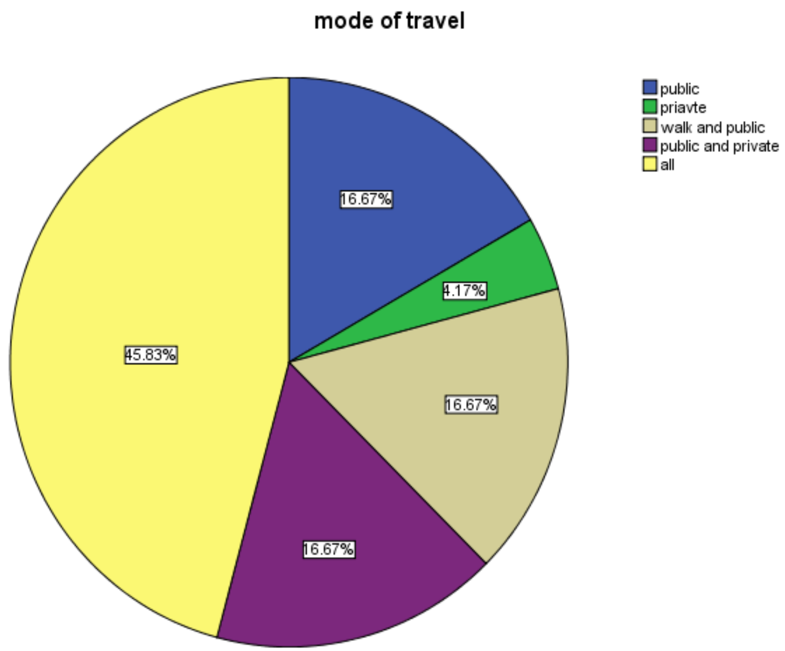
Type of Buildings (For Sustainable Shelter)



Roads (For Sustainable Transportation)



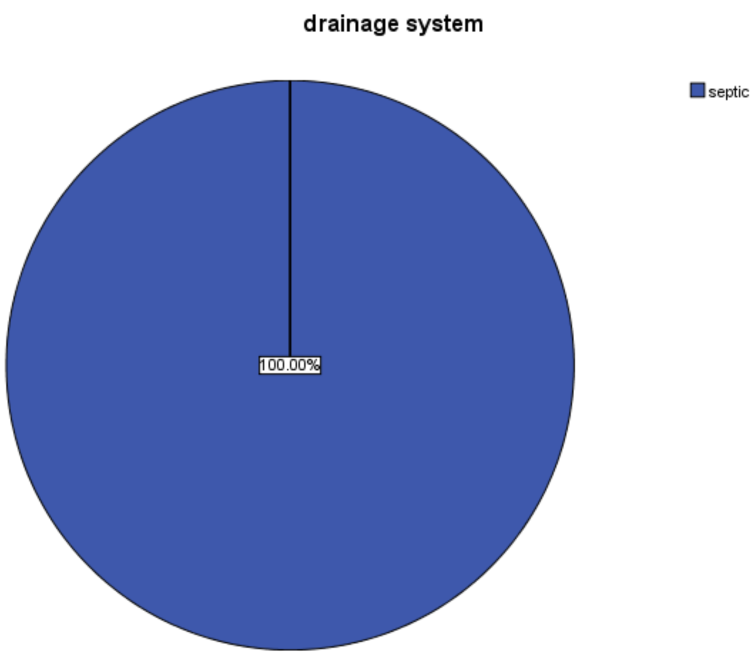
Mode Of Travel



Majority of the people have got variety of choices to travel from one place to another using public, private and both means of transport. In the nearest area people walk on foot but in far distant they don't walk but use different means of transport.

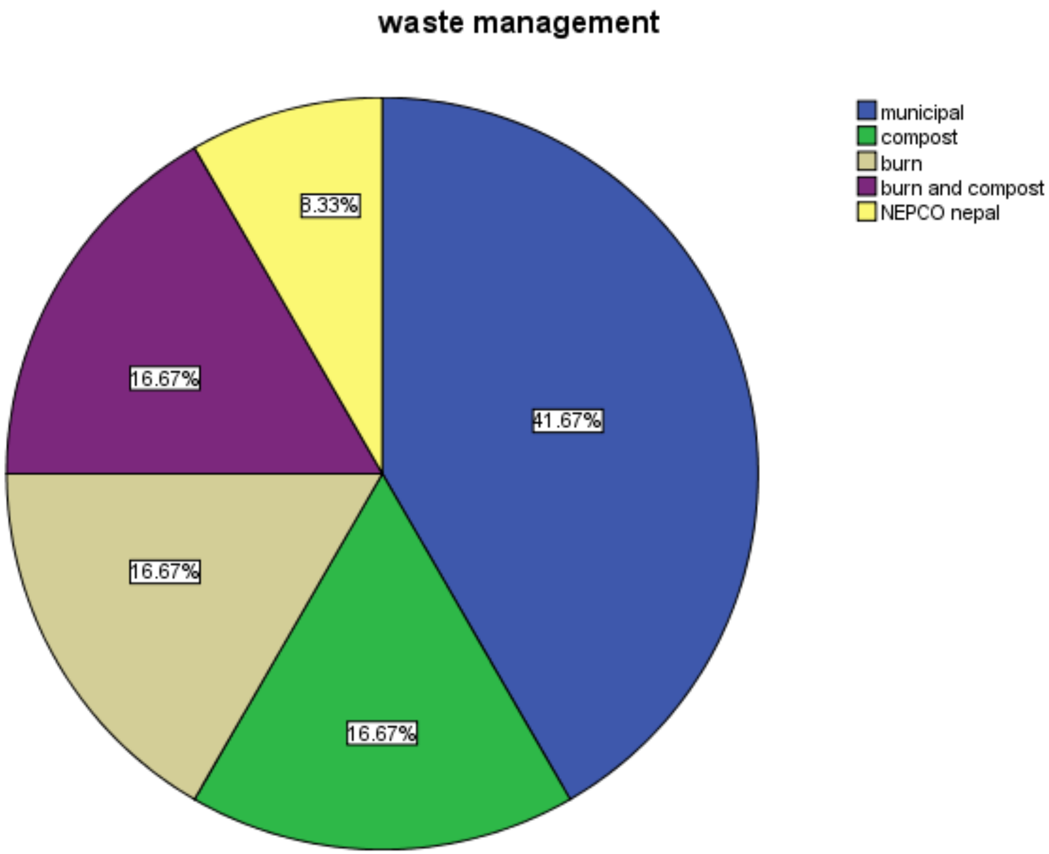
Sewer (Drainage)

(For sustainable Health)



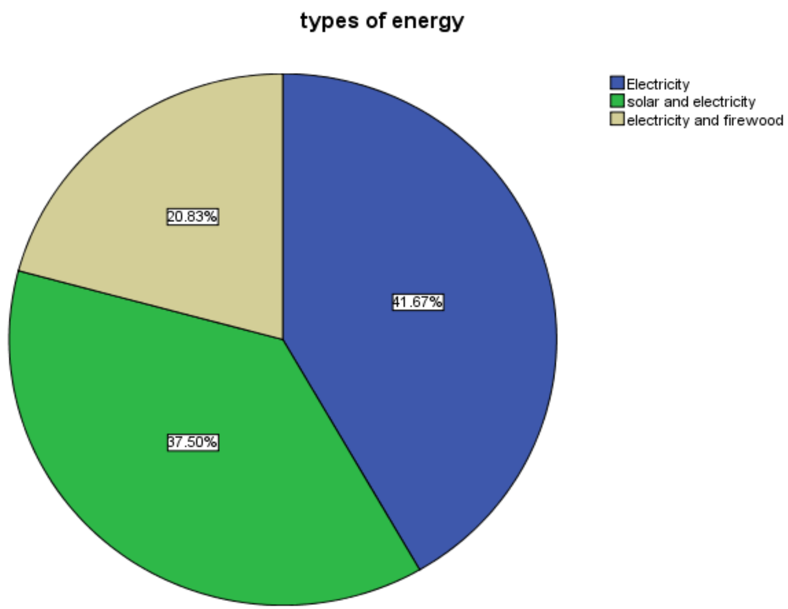
All the houses have septic tank which gives the great possibility of biogas generation if some technical mechanism is introduced in this area through municipal level. The solid sludge of septic tank causes bad smell and pollutes the environment. It can cause airborne and waterborne diseases to children as well as adult population.

Solid Waste Management



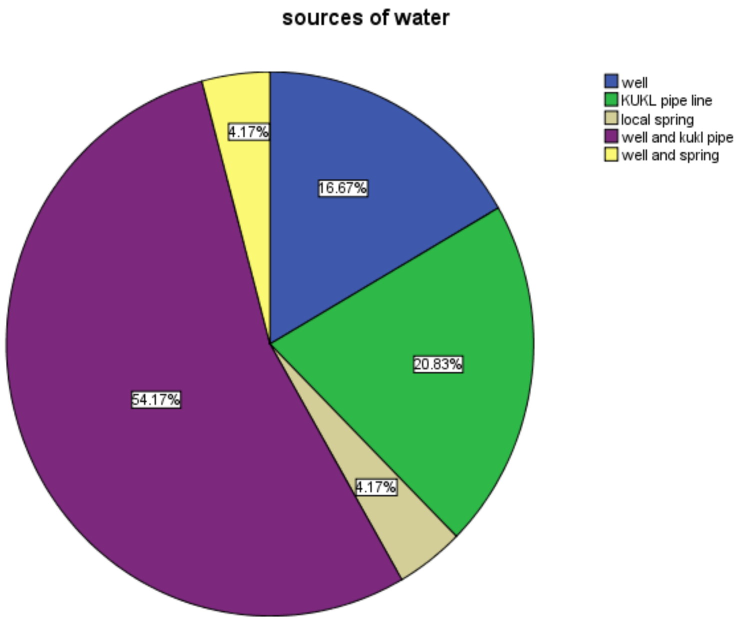
In this area, about 41.67% of the wastes produced are collected by the municipality vehicle whereas 16.67% of wastes are allowed to make compost by the people to manufacture compost manure for their field. The biodegradable wastes are burnt and changed into ashes and composted in the particular area. One of the social organization like NEPCO Nepal collects about 8.33% of the wastes produced at Thaiba at regular interval of ..or once in a month. The compost manufactured in Thaiba is sustainable instead of using chemical fertilizer for agriculture.

Energy



In terms of energy, the whole area of Thaiba is facilitated by the NEA electricity line. Apart from this about 37.5% of the household have use electricity as well as the solar energy. The ambient sunlight is available all day time. Having such potentialities, Thaiba is not successful to show itself as sustainable in terms of solar energy at present. Firewood also another source in rural area.

Water Supply



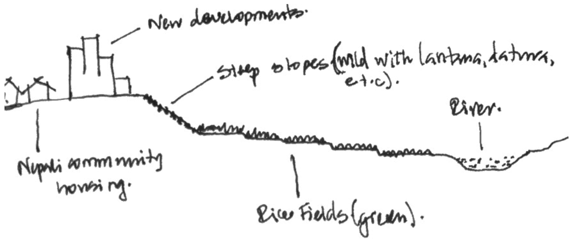
In the core rural areas, springs are the main sources of water. In rural area, well and springs are the main sources of water. In urban area, well and KUKL water supply are the main sources of water whereas in the core urban area only KUKL water supply is the main sources of water. Whenever one sources gets affected other alternative source can be used making it a sustainable area.

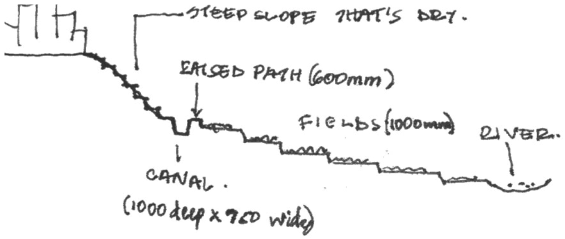
Contd. (Water supply)

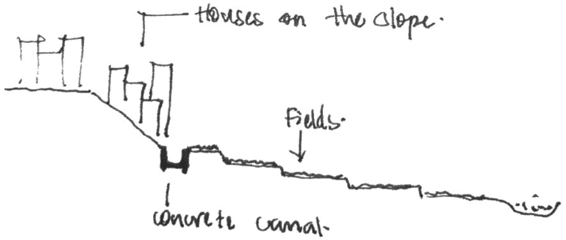
4. OUTCOMES OF THE EXERCISE ON BGM KHK

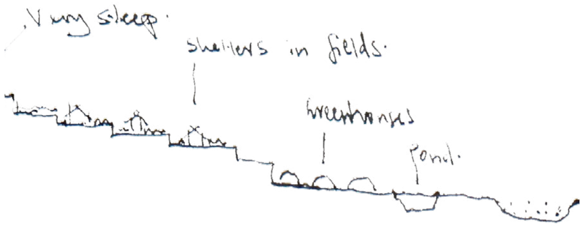
The fault line between urbanisation and agriculture

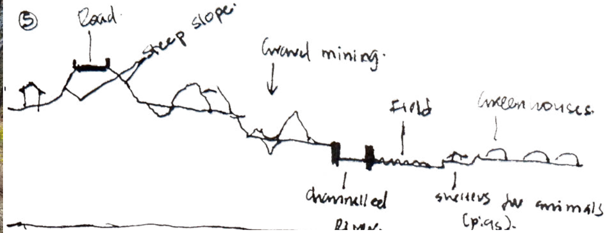
THE SEQUENCE OF SCENES ALONG THE IRRIGATION CANAL

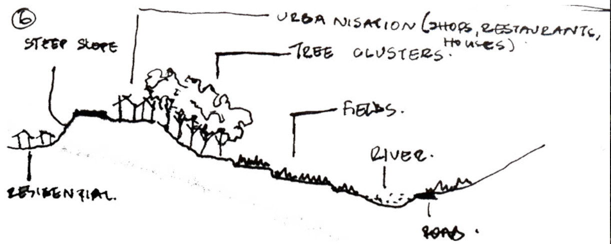


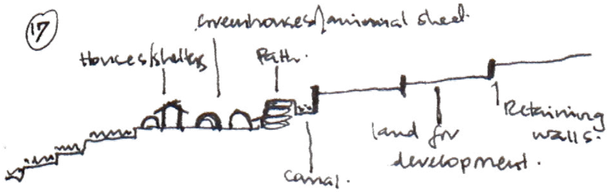




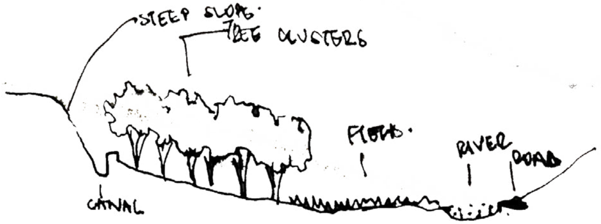


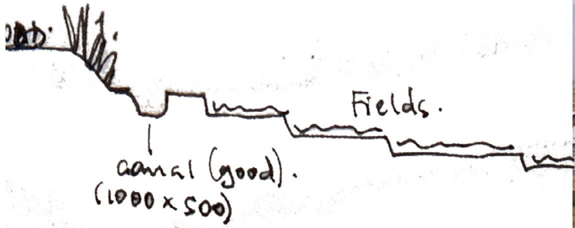


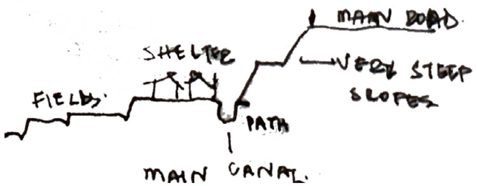


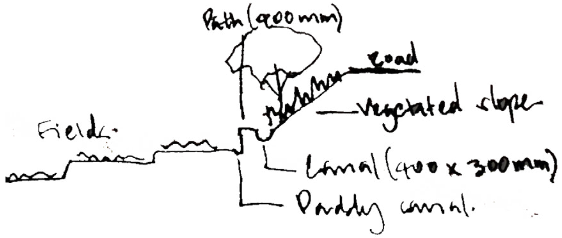


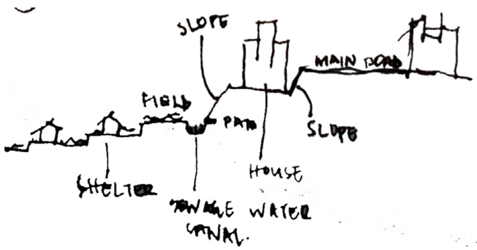
THE SEQUENCE OF SCENES ALONG THE IRRIGATION CANAL

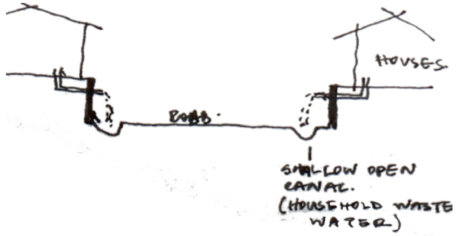


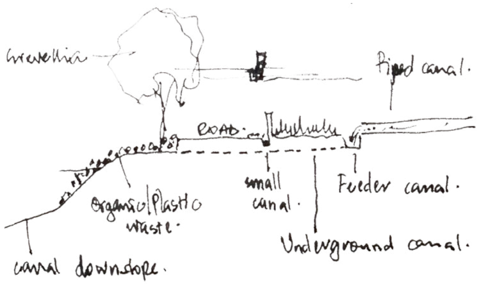


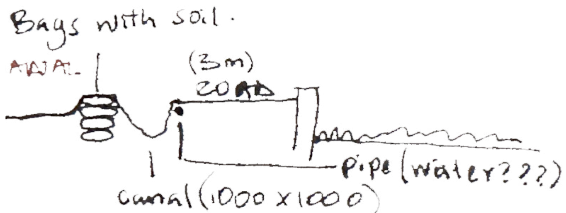




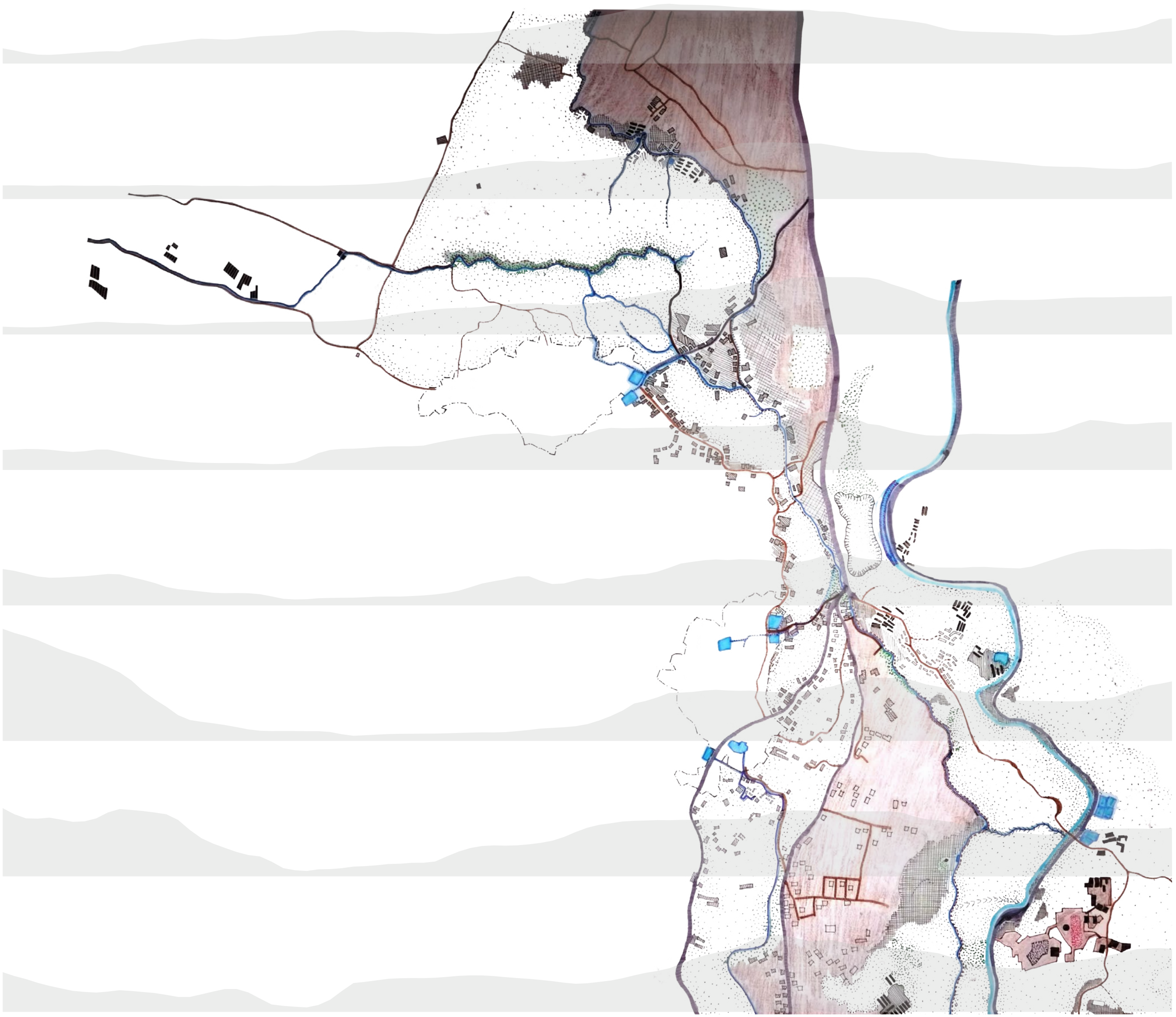




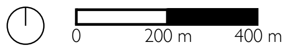


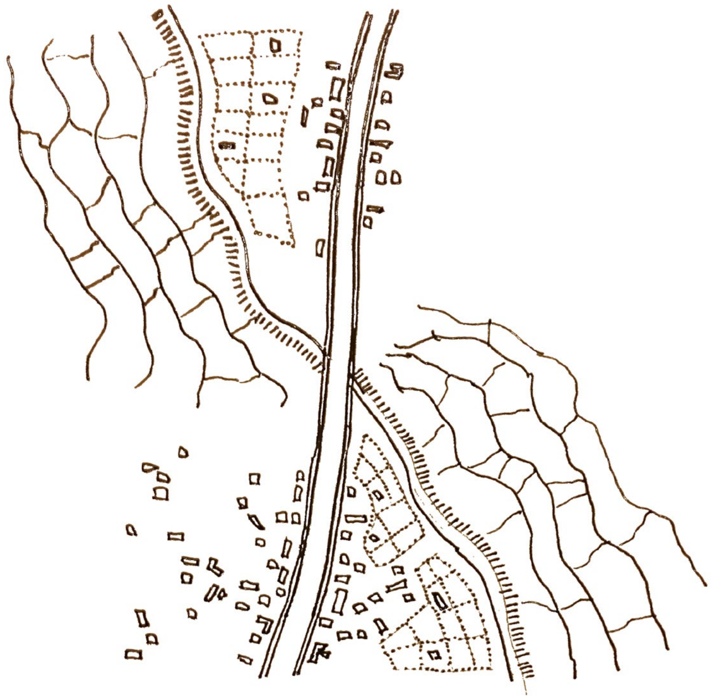


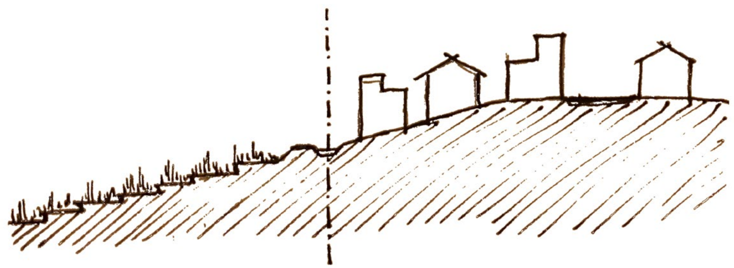
HOW DOES THE WATER SYSTEM ORGANISE THE (URBAN) LANDSCAPE?



The canal is directly related to many other landscape features like agriculture fields, creeks and village ponds





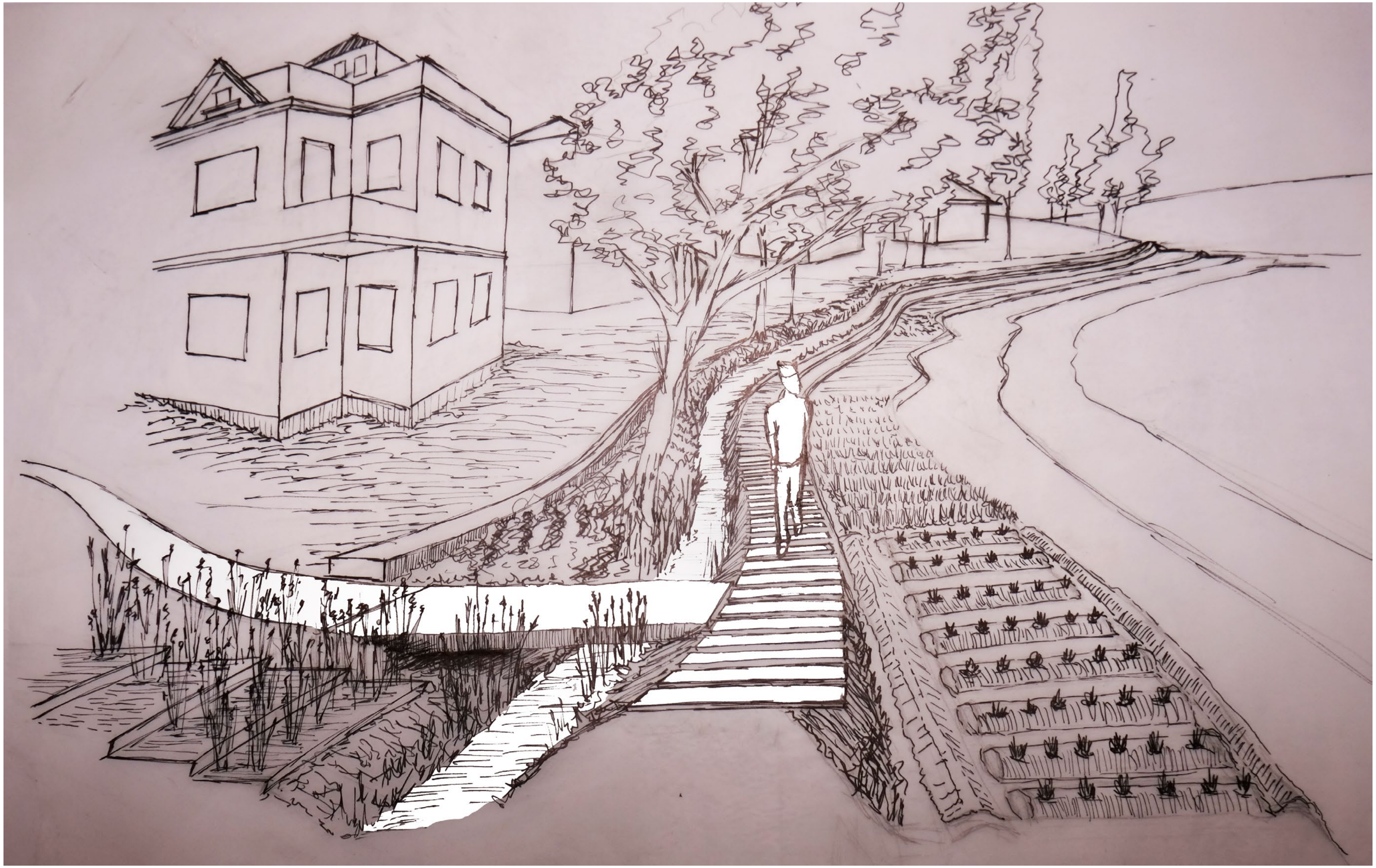


The canal forms the border between the agriculture fields downhill and urbanisation uphill

IS THE CANAL BEING APPROPRIATED AS A SPACE BY THE LOCAL COMMUNITY ?

Based on a stationary count, the canalside seems to be used by pedestrians rather frequently.

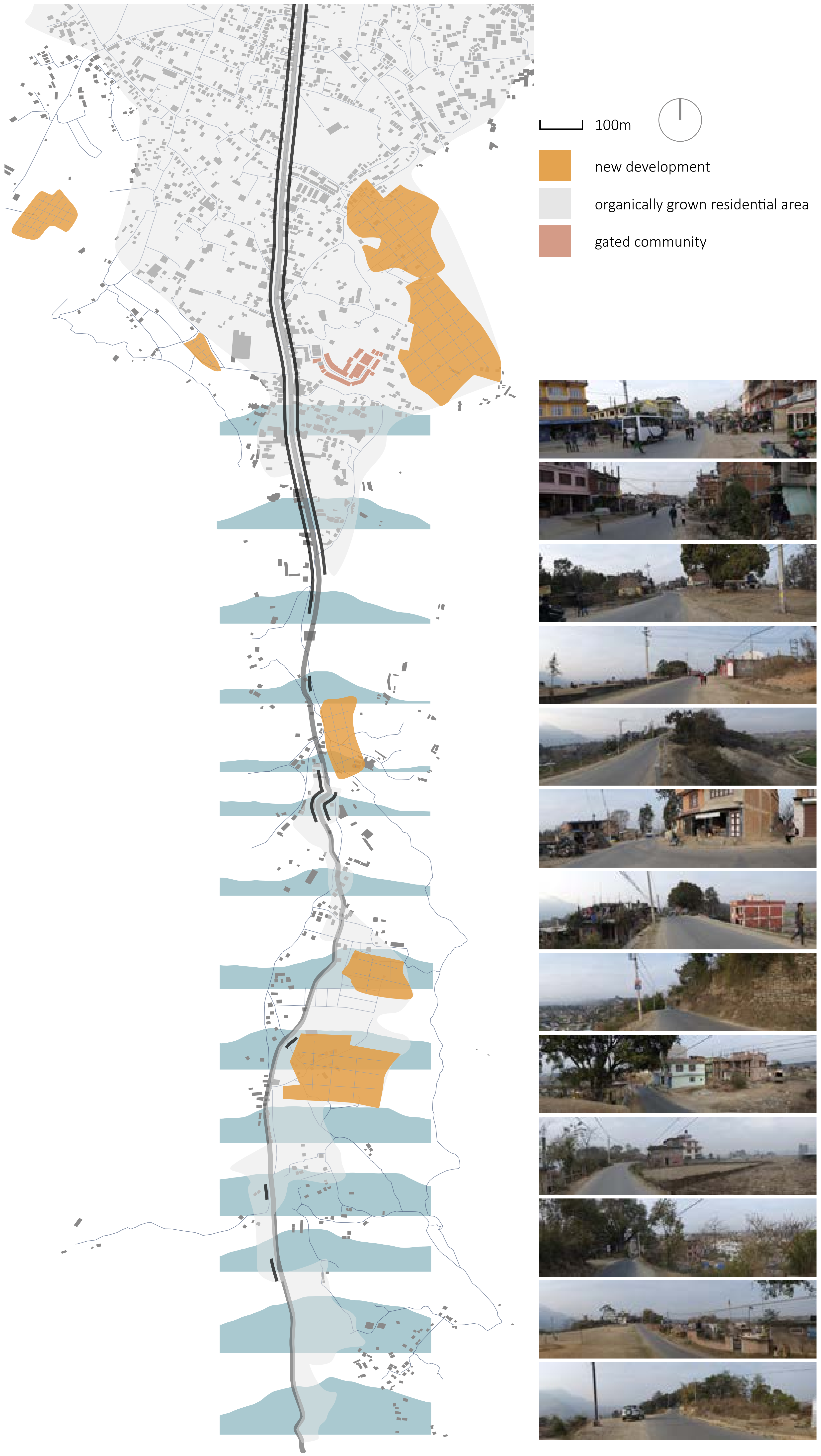
CAN THE CANAL BE RE-IMAGINED AS AN ACTIVE BORDER BETWEEN URBANISATION AND AGRICULTURE?



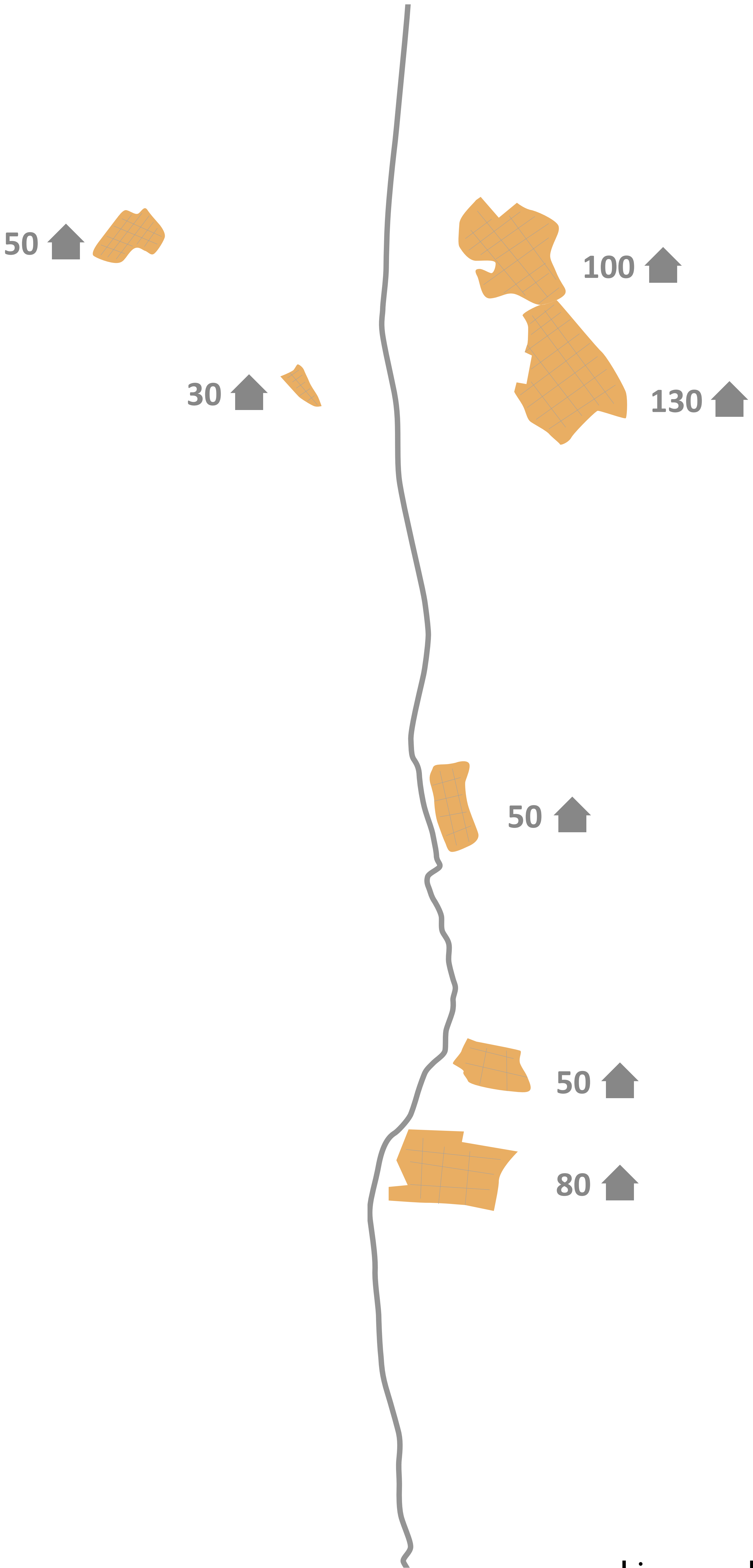
MORPHOLOGIES OF TRANSITION

Exercise 1 Typologies
Kato Allaert & Wim Bruneel

TRANSITION FROM URBAN TO RURAL



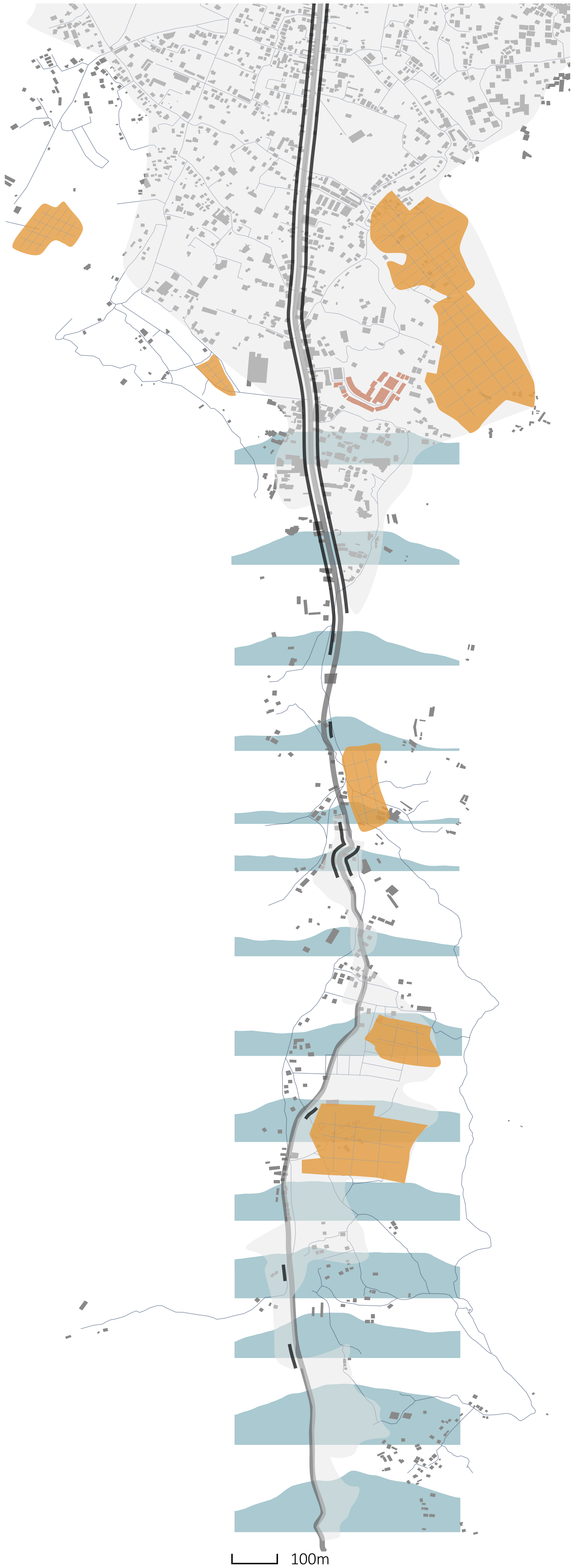
Planned developments



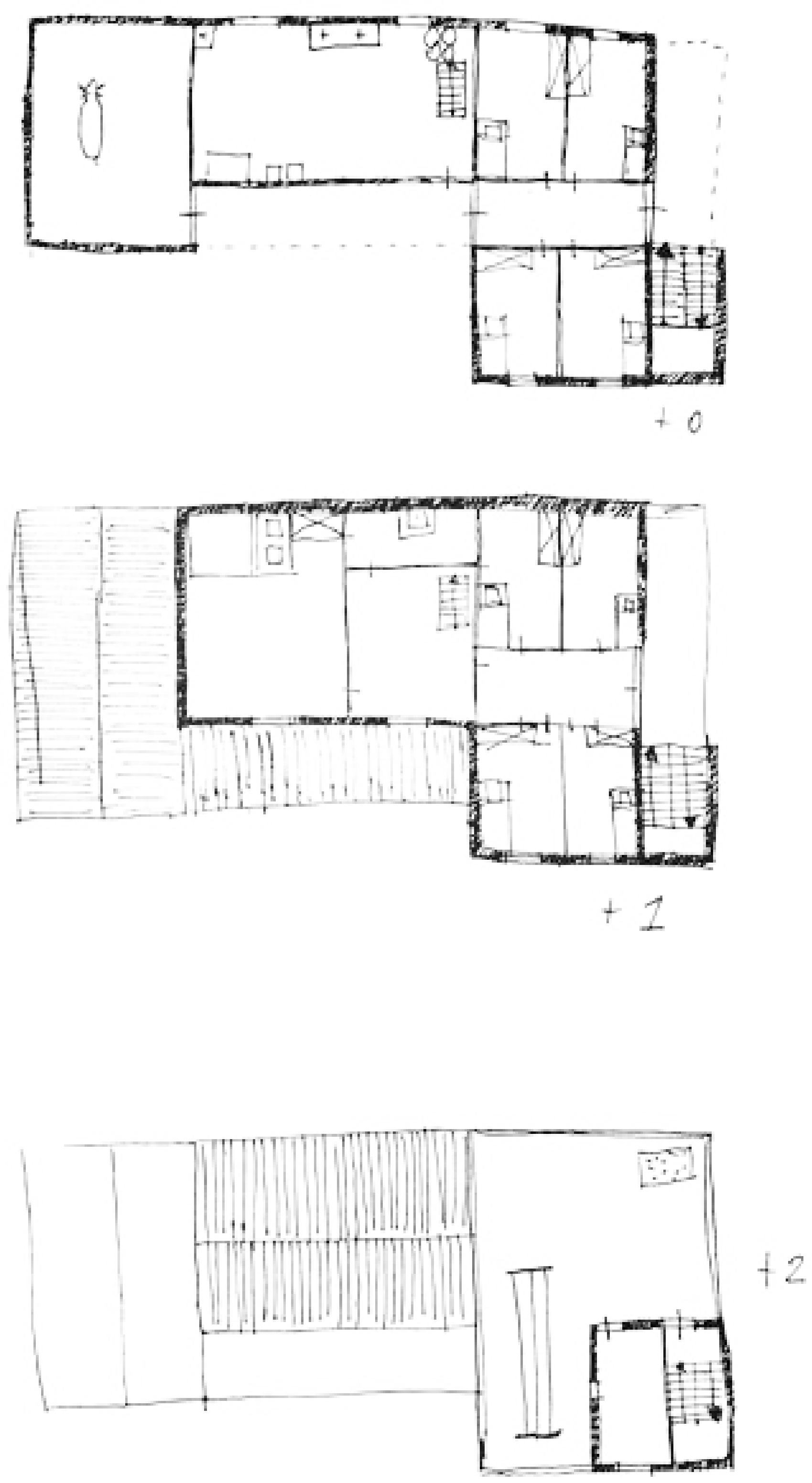
Ribbon development

Linear urban transitions along the Ekantakuna Road

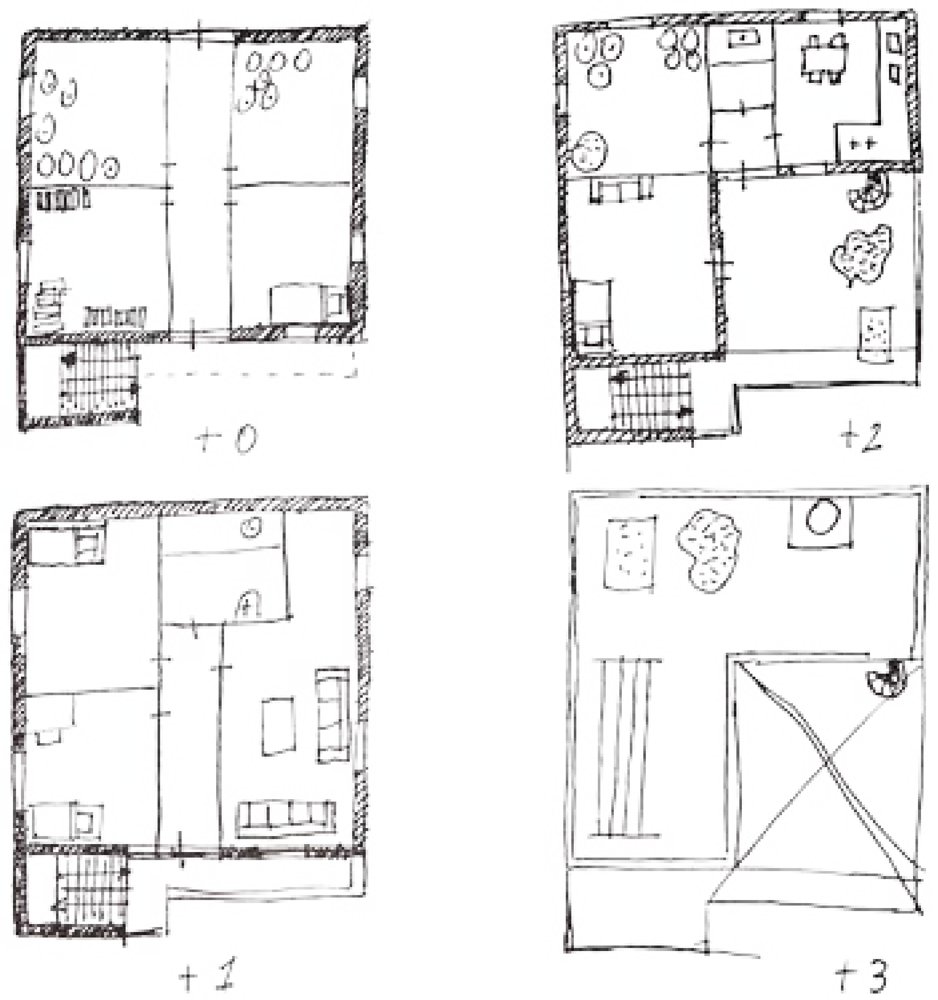
TRANSITION OF TYPOLOGIES



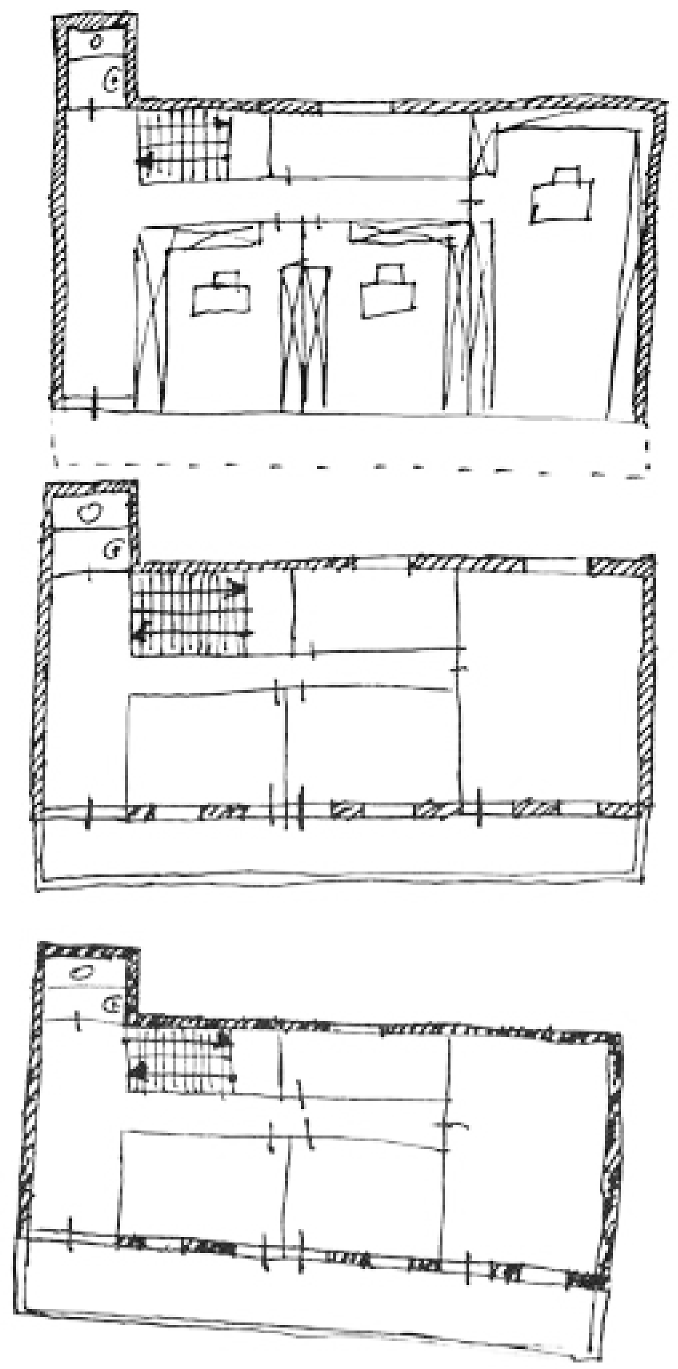
Nepali house
traditional house located in rural areas



Namaste style house
contemporary house located in urban and new developed areas

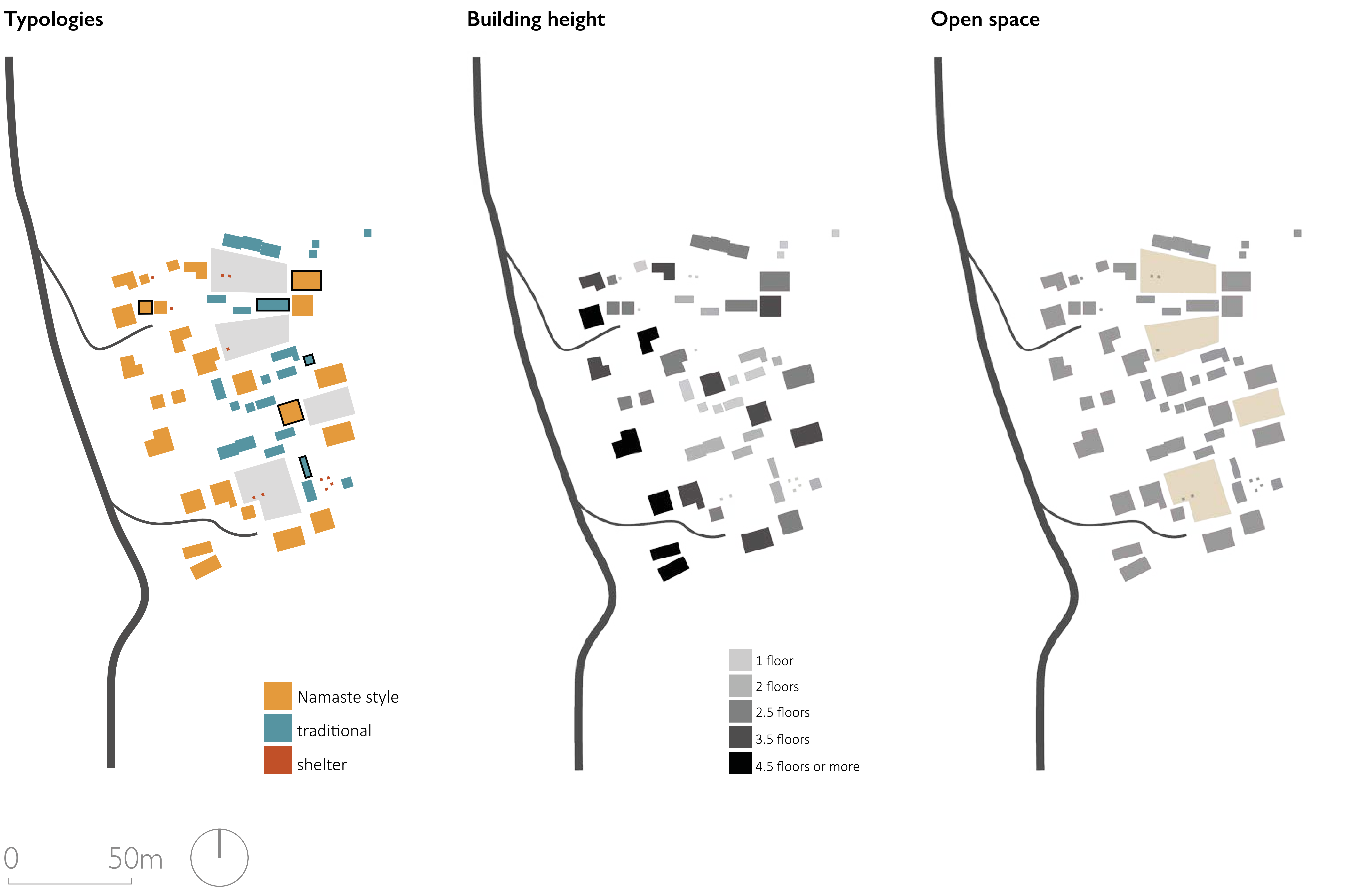


Shop house
mixed use building located in ribbon development in urban areas



Namaste style houses - the new vernacular?

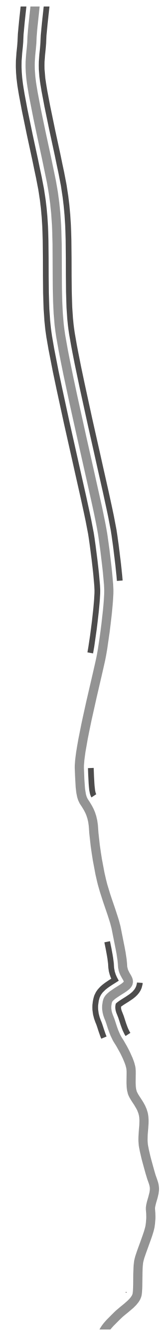
TRANSITION OF A RURAL SETTLEMENT: CHUNIKHEL



The gradual transformation of a traditional settlement

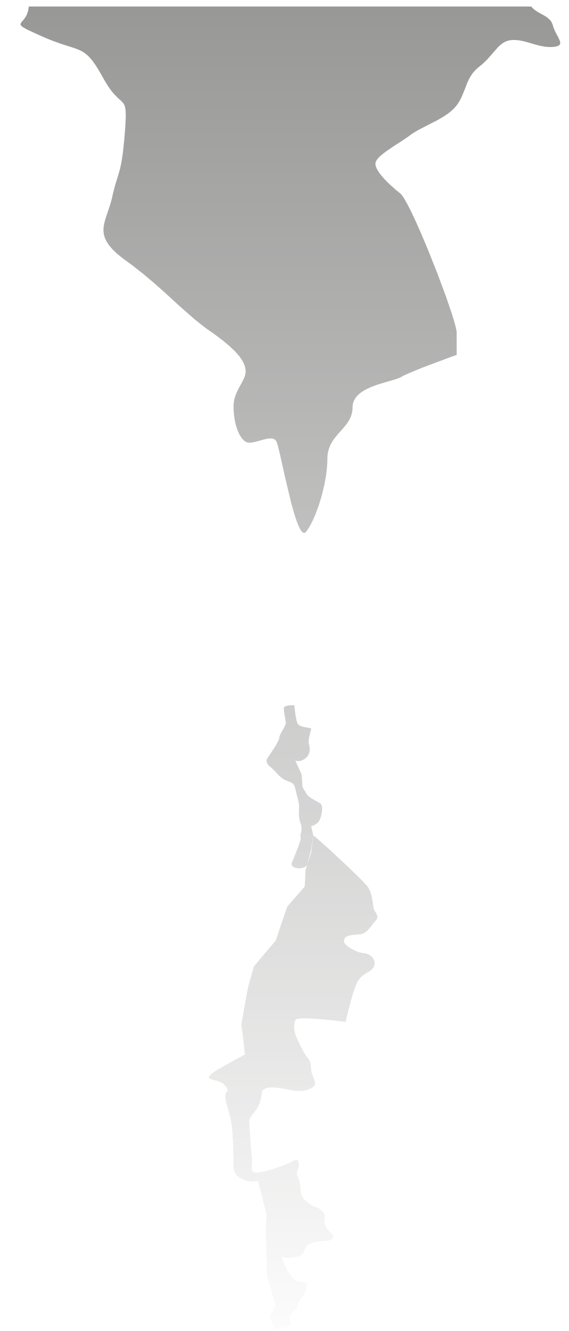
MORPHOLOGIES OF TRANSITIONS

Transition from rural to urban

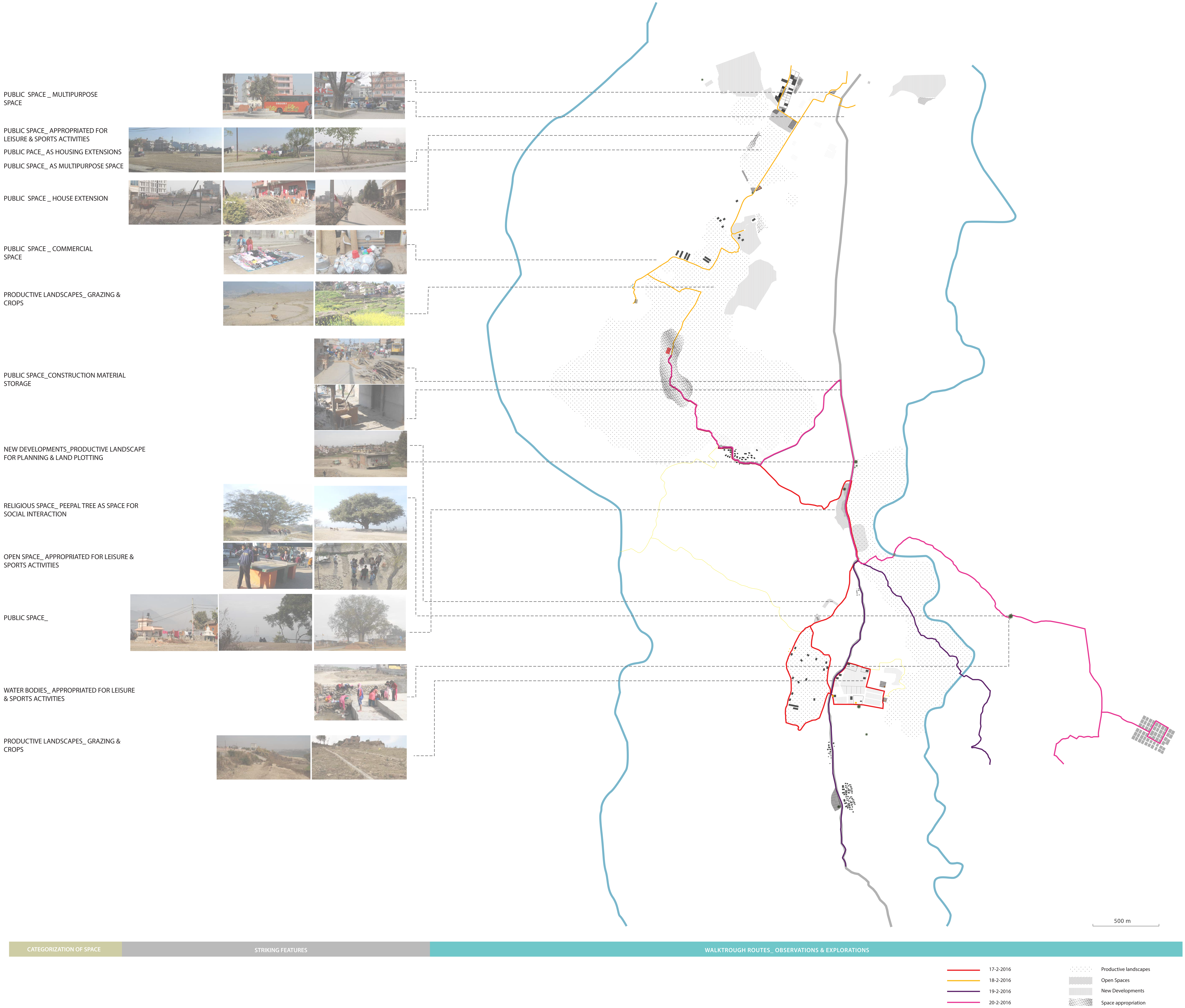


Transition of spaces

Transition of typologies



How to deal with gradual transformation on different levels?



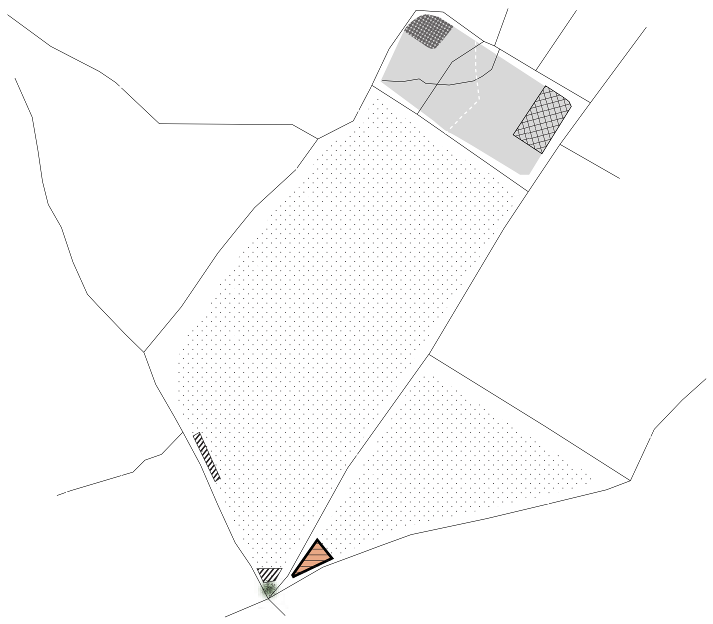
PUBLIC SPACE _ MULTIPURPOSE SPACE
PUBLIC SPACE_ APPROPRIATED FOR LEISURE & SPORTS ACTIVITIES
PUBLIC PACE_ AS HOUSING EXTENSIONS
PUBLIC SPACE_ AS MULTIPURPOSE SPACE
PUBLIC SPACE _ HOUSE EXTENSION
PUBLIC SPACE _ COMMERCIAL SPACE
PRODUCTIVE LANDSCAPES_ GRAZING & CROPS
PUBLIC SPACE_CONSTRUCTION MATERIAL STORAGE
NEW DEVELOPMENTS_PRODUCTIVE LANDSCAPE FOR PLANNING & LAND PLOTTING
RELIGIOUS SPACE_ PEEPAL TREE AS SPACE FOR SOCIAL INTERACTION
OPEN SPACE_ APPROPRIATED FOR LEISURE & SPORTS ACTIVITIES
PUBLIC SPACE_
WATER BODIES_ APPROPRIATED FOR LEISURE & SPORTS ACTIVITIES
PRODUCTIVE LANDSCAPES_ GRAZING & CROPS
500 m
CATEGORIZATION OF SPACE
STRIKING FEATURES
WALKTROUGH ROUTES_ OBSERVATIONS & EXPLORATIONS
17-2-2016
18-2-2016
19-2-2016
20-2-2016
Productive landscapes
Open Spaces
New Developments
Space appropriation

How can design strategies can benefit from the mismatches of vacant spaces and informal use of public space?

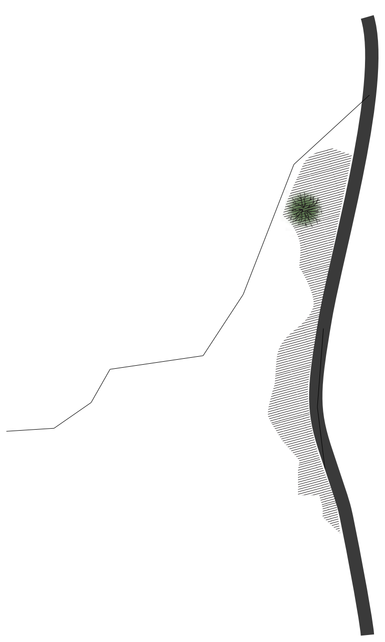
Can design strategies enhance the current conditions in which informal usage of public space is occuring?

The multiple and various usages of public spaces (streets) in the Nepali context should be taken into account on the provision of flexible and multi-purpose spaces.

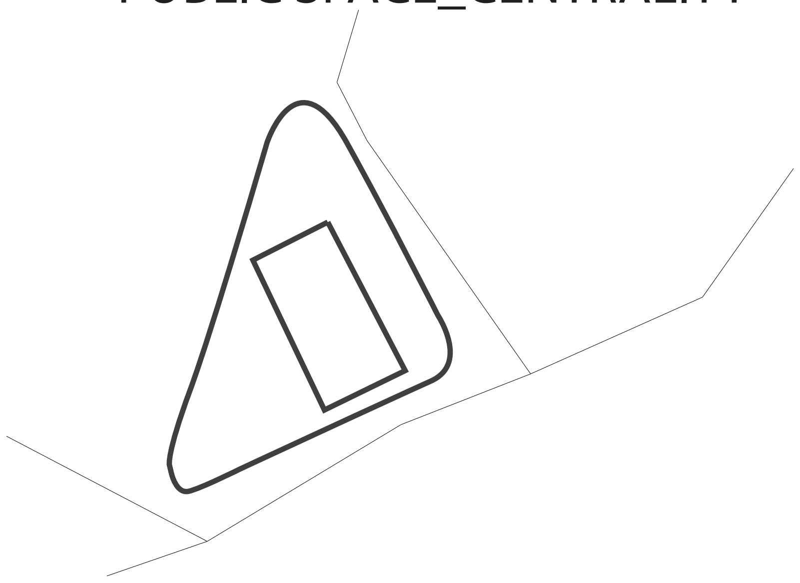
PUBLIC SPACE_MULTIPURPOSE SPACE



PUBLIC SPACE_VIEWPOINT



PUBLIC SPACE_CENTRALITY



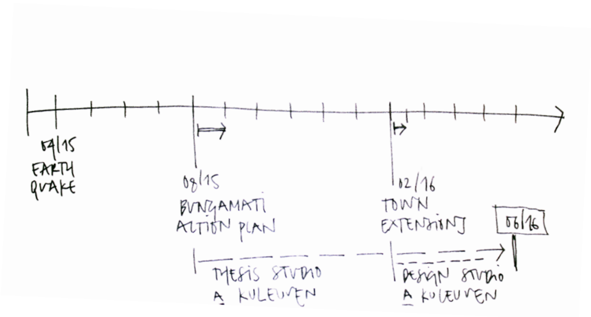
5. CONCLUSION

conclusion

start of a design studio

fieldwork as a necessary basis to understand the territorial logics: spatial /social/ economic/...

how can the peri-urban context of Kathmandu prepare itself for the coming urbanisation, with respect to its landscape and traditions, and whitout falling into a speculative land consumption ?



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Assessing the Sustainability, Planning of Bungmati

072 BATCH

TO:
Prof. Dr. Sudha Shrestha
Asso. Prof. Dr Sushil B Bajracharya
Asso. Prof. Sangeeta Singh

By:
Mimang Hang Kirat 072/MSES/454
Niranjan Shrestha 072/MSES/455
Pramila Dhaubanjar 072/MSES/457
RM Pandey 072/MSES/459
Sudikshya Uprety 072/MSES/462

March, 2016

1

INTRODUCTION

- Traditional Newar Settlement
- Satellite Town of Patan
- Population – 5,667 (2001), 5,720 (2011)
- AREA = 4.06 sq km/406 ha
- Population Density
  - 1409 per sq km
  - 14.09/ha

2

Methodology

Data Collection: Observation | Interviews | Maps

Data Analysis: Literature Review | Descriptive Statistics | Time Series Analysis

↓

Conclusion and Recommendation

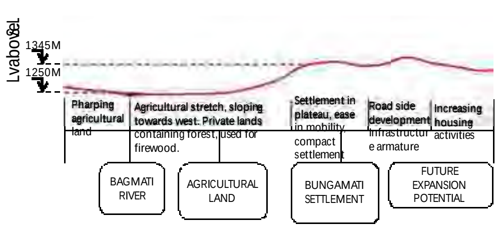
3

Parameters Identified

- Land Use Pattern
- Energy Use and Source
- Infrastructures
- Water Supply
- Solid Waste Management
- Transportation
- Agriculture

4

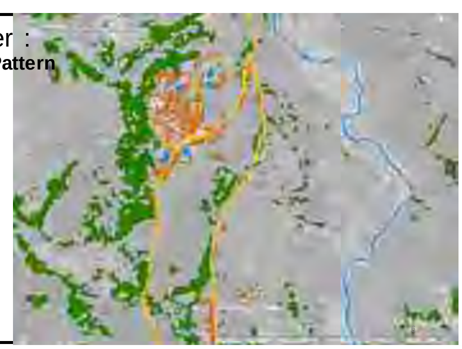
Parameter : **Land Use Pattern**



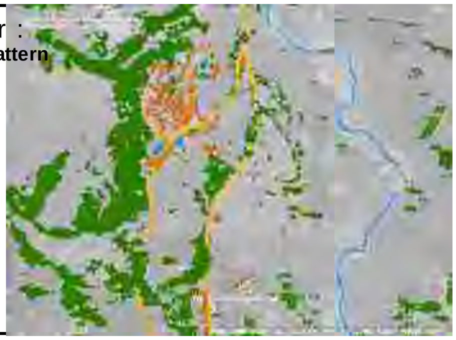
5

Parameter : **Land Use Pattern**

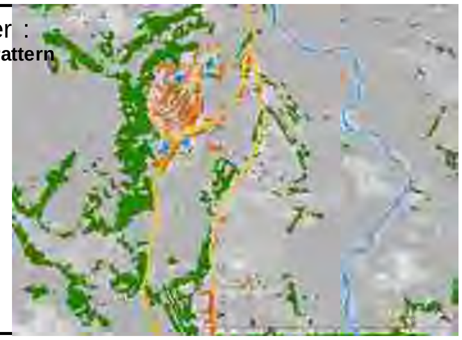
2003



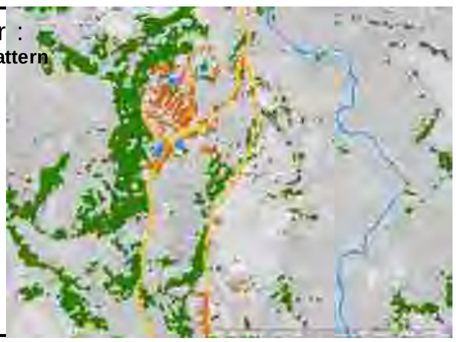
Parameter :
Land Use Pattern
2004



Parameter :
Land Use Pattern
2007

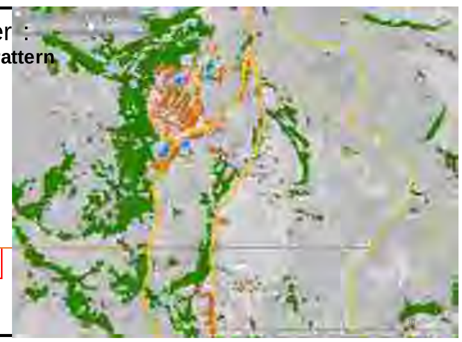


Parameter :
Land Use Pattern
2009

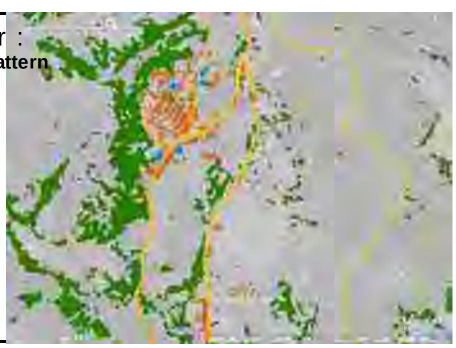


Parameter :
Land Use Pattern
2010

Water Body disappears



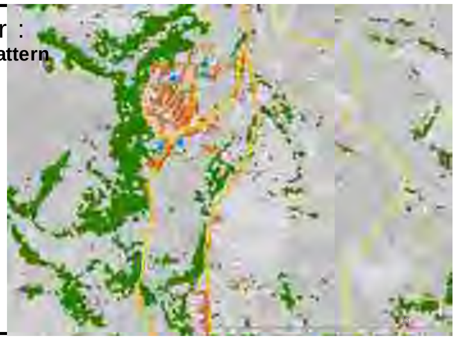
Parameter :
Land Use Pattern
2011



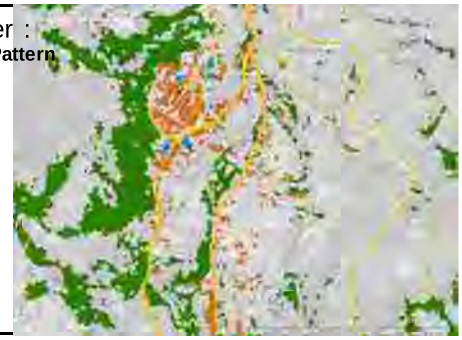
Parameter :
Land Use Pattern
2012

Attempt on Plotting on land

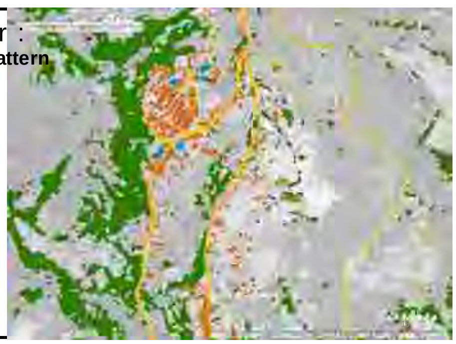
Parameter :
Land Use Pattern
2013



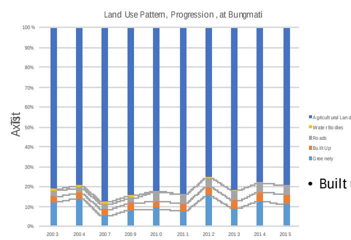
Parameter :
Land Use Pattern
2014

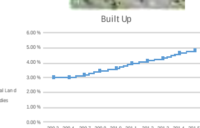


Parameter :
Land Use Pattern
2015



Parameter : **Land Use Pattern**

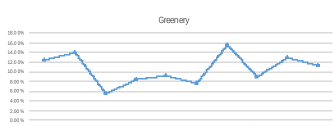


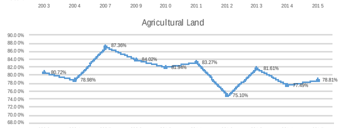


- Built up Space gradually increases

16

Parameter : **Land Use Pattern**





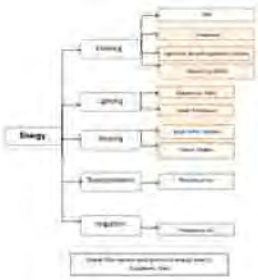
- Both Greenery and Agricultural Land Fluctuates up and down
- But maintains a constant value
- Maybe because the forest is communal, some parts private as well
- Shows a subtle consciousness of the people

17

Energy Use

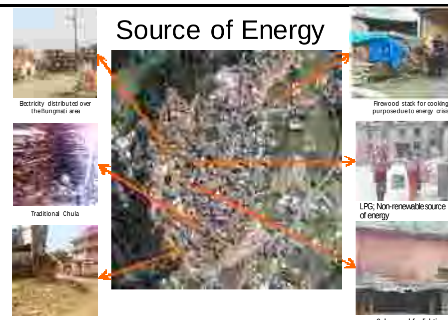
18

Energy used pattern and sources



19

Source of Energy



Electricity distributed over the Bungmati area

Traditional Chula

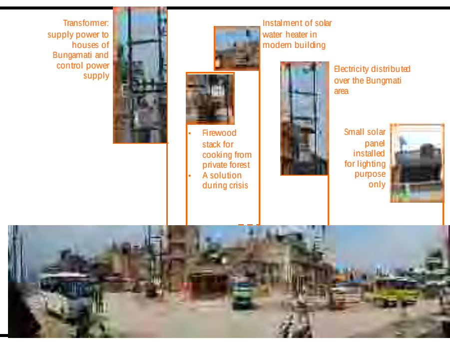
Agricultural Residue use for cooking

Firewood stack for cooking purpose due to energy crisis

LPG; Non-renewable source of energy

Solar panel for lighting purpose only

20



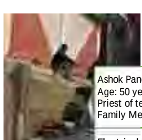
21

Field Interviews

Ganesh Lal Tuladhar
Age: 65
Occupation: Cafeteria at Buspark
Family Member: 6

Electrical Devices:
Television: 1
CFL: 2 (Kitchen and passage)
Tube light: 1 (bed)
Fan: 1
Refrigerator: 1
Washing Machine: 1
Total unit/ month: 25 units
Total charge/month: 200-300 NRs
For cooking
LPG: 2 cylinder/month
Firewood

22



Ashok Paneju
Age: 50 years
Priest of temple
Family Member: 8

Electrical Devices:
Television: 3 (1 LED)
CFL: 2
Tube light: 2
Fan: 1
Computer: 1
Inverter: 1

Total charge/month: 300-400 NRs
For cooking
LPG: 1 cylinder/month
Firewood

Nani Maya Maharjan
Age: 36 years
House wife
Family Member: 4

Electrical Devices:
Television: 1
CFL: 2
Florescent bulb: 2
Water pumping machine: 1

Total charge/month: 200-250 NRs
For cooking
LPG: 1 cylinder/ 2month
Firewood

23

Traditional cooking stove - problems

Health problems

Only one cooking pot can be used at a time.

Smoke entering into the kitchen room leads to indoor air pollution.

Fire spreads out of cooking pot

Low thermal efficiency

The smoke makes the cooking pots dirty and increases the work load of women.

Take more time to cook so needs lots of fuel.

This creates a risk of fire hazard.

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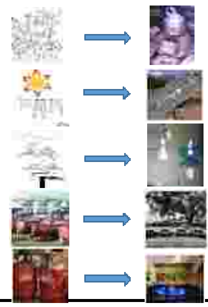
Sustainability of sources



Non-renewable source

Renewable source

Renewable source

Non-renewable source

Non-renewable source

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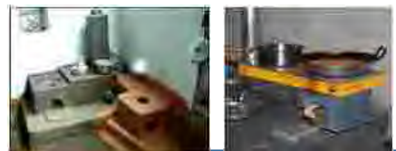
Alternative: Improved Cooking Stoves



- A device designed to consumes less fuel, save cooking time and convenient in cooking process.
- Made from local material
- Cost of installation: 300-400 NRs (mud material)

(https//ioemsre.wordpress.com)

Direct and indirect benefits

- Consumes less fuel (reduce 50% fuel)
- Increased thermal efficiency. (15%- 25%)
- Conservation of forest.
- Reduction in indoor air pollution.
- Reduction of cooking time and work load.
- Prevention from fire hazard.
- Reduction in GHGs emission.

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Solar Energy

- Ø A renewable , clean source of energy.
- Ø Environmentally friendly source of energy.
- Ø Reduce the use of fossil fuel.
- Ø Free source can be use by anyone in abundance.
- Ø Reduce environmental pollution.

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Infrastructure

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Infrastructure

- Physical Infrastructure
  - Road network
  - Water supply
  - Electricity
  - Sewerage

Socio-cultural Infrastructure
- Temple
- Open spaces
- Paati
- Pond
- Library
- School
- Economical
  - Weaving
  - Carpentry
  - Shops with Daily essentials
  - Commerce and banking

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ROAD NETWORK: Hierarchy

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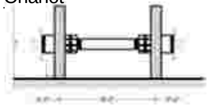
Rato Machhendranath Chariot



Machendranath Chariot resting spot before the Jatra starts, an open shrine close to buspark, in front of Kumari Sattal

'Machendranath' having many important mythological, historical and contemporary ritual associations with water is a primordial rain god [Slusser, 1982; Locke, 1975, 1980]

Celebrating Machhindranath - Bungamati is the starting point of a procession for the Machhindranath God during the important festival. The public space is filled with people following the charriot on its route to Patan.

P.C.: Hari Maharjan, ECSNEPAL

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Chariot storage

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Water supply system

- Water mainly for four categories; Drinking purpose, Cattle and agriculture water demand, basic domestic uses, and traditional ritual requirements.
- Portable water ->Jwalakhel Drinking water limited ->Pharping water Supply
- Bungmati pump house from where water is pumped to the several public water distribution junctions of the area
- Public tap is the source of portable water (contributes to social life)
- not adequate enough to fulfill the requirement (2times per week)

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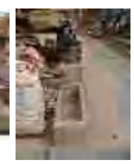
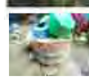
TRADITIONAL WATER INFRASTRUCTURE





Wells, Water reservoir, ponds

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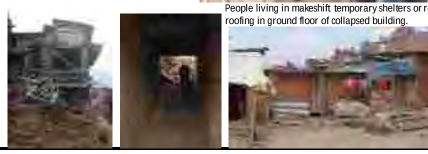
Housing Infrastructure

- Traditional houses suffered damage and destruction due to Earth quake at 2015 earthquake damaging 900 out of 1114 houses.
- Adaptation of modern construction technique
- this may result in loss of architectural identity
- Traditional construction materials inculed brick, timber, stone and mud.
- Energy demans for construction

People living in makeshift temporary shelters or re-roofing in ground floor of collapsed building.



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Debris from collapsed buildings

Dumping of building ruins from earthquake.
This resulted in change in natural topography and threatening existing vegetation (bamboo specimen), which were rooted to soil of steep slope.

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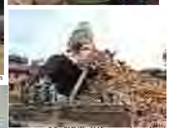
Socio-cultural Infrastructure





PC:jean-claude baise, panoramio.com

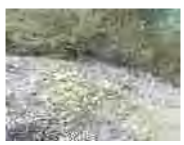

P.C.: BMS World Mission workers in Nepal

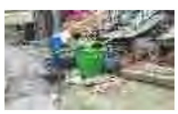
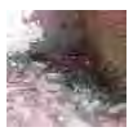
Heritage rebuilding challenge ahead.

Solid Waste Management

Solid Waste Management

- Mixed type
- Municipal Garbage Collection
- Composting of Organic material at domestic level
- Random disposal off the cliff at the end of built-up area and settlement area.

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Solid Waste Management

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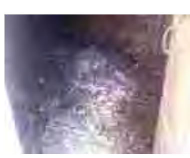
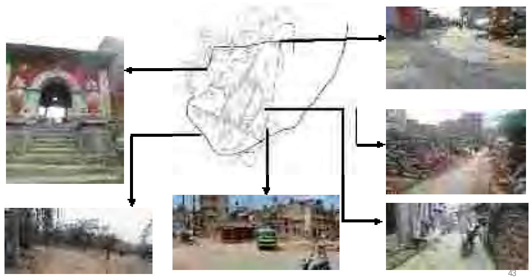


TRANSPORTATION SYSTEM

Transportation system



MODE OF TRANSPORTATION

- PEDESTRIAN:
- One of the old traditional settlement.
- With a definite purpose of fulfilling all the basic services, sociocultural rituals as well as maintaining the linkages with the neighboring lands.
- The routes in the settlements are pedestrian friendly

Public transport

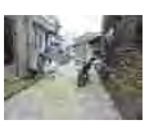
- Governing mode for the inter connection of Bungamati with other cities.
- Bungamati has an old bus park with the parking area capable for about 20 buses.
- Routes:
  - Bungamati-Jwalakhel
  - Bungamati-Ratnapark
- Number of trips made per day is about 5:1 ratio; Fuel Crisis
- The service availability begins from about 5:30 a.m. and terminates at about 7:30 p.m. each day.
- Headway interval between the two arriving Buses is about 20 minutes.

Public transport

- The density of passenger is very high at office hours and early morning college hour.
- 75% of the total passengers at morning are students.
- Apart from this routine travel pattern, density of passenger is tremendously high at the festive season.

Private Transport

- Motorbike is other preferred mode.
- Cycles used to be one of the dominating mode used, about a decade ago. however at present it has been replaced by motorcycle.



Factors affecting transportation

Economic

- Agriculture
- Wood carving
- Tourism
- Carpet Manufacturing
- Business
- Occupation within walkable distance.
- No off Bungamati travelling required.





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social

- Daily Life Style
- Interaction of people at public spaces
- Communal Relationship
- Festival Celebration
- Encourages more Pedestrian tendencies





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Challenges

- Massive earthquake destruction
- Temporary shelter placement in agricultural land
- Scattered settlement
- Loss of communal relationship
- Privacy seeking tendency
- Sustainability hazard


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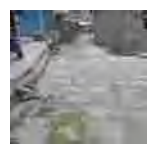
Environment

- Air pollution, Spirit of the city
- Mutual Relationship- pedestrian and environment



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Environment

- Developing Status of adjacent sites
- Vaisepati area and it's development Pattern
- Colonies and construction attraction
- Effect in transportation system
- Quality & Quantity


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Other Plans and policies of government

- Outer Ring road

- Source: (http://kathmandupost.ekantipur.com/news/2015-09-01/trains-wanted.html)

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Water Supply System

Issues

Pipeline based water supply (existed more than 30 yrs before – new pipeline 2-3 yrs ago)

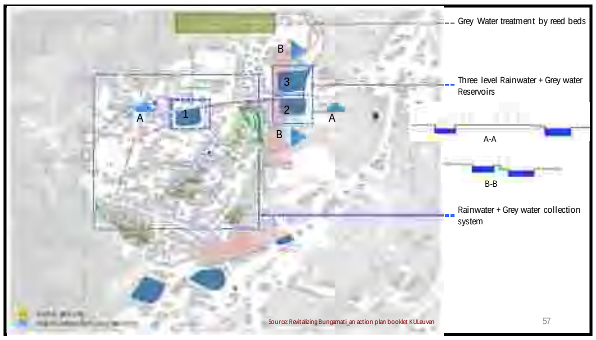
Twice a week
Stored in Community water tank and personal drums (need pump)

Community wells dried out 15-16 years ago
Washing often done at Nakhkhhu river

Recently dug wells 5-6 only for washing and animals

Use of ponds decreasing

Dependent on Pharping water sources



Grey Water treatment by reed beds

Three level Rainwater + Grey water Reservoirs

Rainwater + Grey water collection system

Source: Revitalizing Bungamati_an action plan booklet KULeuven

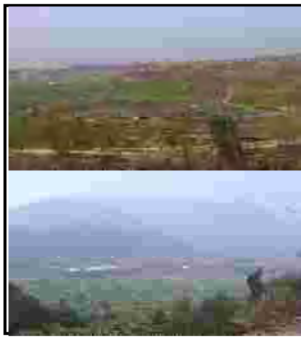
Agricultural Land Use

Machhindranath Jatra Source: Revitalizing Bungamati_an action plan booklet KULeuven

Bunga-Dyo (Rain god)
Bungamati Historically the worshiper settlement of rain for agriculture

Socio-Cultural integration of agriculture in life style

Economical and Environmental balance by agricultural activities



Topographically low valleys

On both sides of the plateau

Personal forest as transition

Edges at Rivers on both sides

Rain water runoff as irrigation

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Source: Various internet sites

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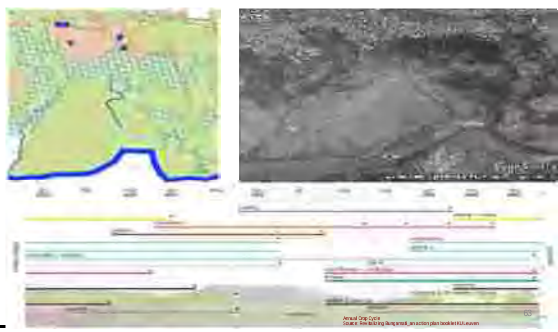

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Issues

Increasing use of Chemical Fertilizers (Urea + Potash)

Decreasing animal husbandry after tourism development

Agricultural land encroachment settlement expansion

Lack of sufficient Irrigation dependence on rain water

Lack of means of transportation

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2003

2012

Challenges

Land use change to more economic

Increasing Mechanized practice (High labor charge)

Decreasing interest in Agriculture

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Conclusion and Recommendation

- Land Use pattern is Sustainable but South side growth should be controlled before its too late through policy making
- Transportation – EVs and similar technologies should be introduced
- Street – permeable pavement to recharge ground water
- Agriculture
  - promotion of natural manure
  - Large irrigation project from bagmati

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
M.Sc. IN ENERGY FOR SUSTAINABLE SOCIAL DEVELOPMENT
CENTRAL CAMPUS

Report on

Assessing the Sustainability, Planning of Bungmati

Submitted in partial fulfillment of the course

Energy for Sustainable Rural and Urban Planning

Submitted To:

Prof. Dr. Sudha Shrestha

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March, 2016

Contents

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We would also like to thank the team from KU Leuven, Belgium which included Kato Allaert, Claudia, Stephnie, and others for collaborating with us on a project and teaming with us.

We are grateful to the humble people of Bungmati for being kind to us in sharing their information even when they had been devastated by the earthquake of April, 2015. We are especially grateful to Ganesh Lal Tudhar, Ashok Paneru, Nani Maya Maharjan, Sabindra Shrestha for giving us an in depth insight into the region of Bungmati.

We also would like to remember the efforts of Dr. Santosh Shrestha from Green Homes project of UN Habitat for sharing with us the results of this efforts and for being generous enough to provide us with the time and knowledge about his project and findings.

Introduction

Bungmati, an ancient 7th century traditional newar settlement, created as a satellite town of Patan, one of the three major cities of Kathmandu valley, is situated at around 10km south of the Kathmandu city. It is conjectured from the chronicles and legends that 100 people from each three major cities of the valley, Kathmandu, Lalitpur and Bhaktapur were brought to the area during the reign of king Narendradeva and housed them around the ‘Machendranath’ or ‘Bunga-dyo’ in three different directions with construction of three artificial ponds corresponding to community from each city. The town area of bungmati covers an area of approximately 4.03 sq. km. with a total population being almost constant from 2001 to 2011 census at 5,667 and 5,720 respectively (Shrestha) (Statistics, 2011). The main element of bungmati is the God housed in the machendra bahal, Machendranath or Bunga-dyo, who has been associated with water or rain in the chronicles and the legends. The festival is machendanath is widely received by the population of valley which spans for 3 months along its respective patan-bungmati route. (Leuven, 2015)

Intent

To assess the sustainability of the planning of Town of Bungmati using suitable parameters

Methodology

Observational research or field research is a type of correlational or non-experimental research in which the researcher remarks and records the ongoing behavior in their natural environment and setting without much intervention and without manipulating any variables. It permits measuring what behavior occurs in the natural environment and its salient features. Qualitative and quantitative data are both collected and recorded from the field and analyzed to get the results.

Observational research (or field research) is a type of correlational (i.e., non-experimental) research in which a researcher observes ongoing behavior. There are a variety of types of observational research, each of which has both strengths and weaknesses. These types are organized below by the extent to which an experimenter intrudes upon or controls the environment.

Observational research is particularly prevalent in the social sciences and in marketing. It is a social research technique that involves the direct observation of phenomena in their natural setting. This differentiates it from experimental research in which a quasi-artificial environment is created to control for spurious factors, and where at least one of the variables is manipulated as part of the experiment. It is typically divided into naturalistic (or "nonparticipant") observation, and participant observation. Cases studies and archival research are special types of observational research. (Observational Research, 2016)

After the earthquake of April 25, 2015, the effects cannot be undermined or neglected in the Kathmandu valley, more so over in the town of bungmati where almost all the buildings are destroyed or rendered uninhabitable. And again exacerbating to this, the unofficial blockage at the Indian border points has drastically decreased the supply of everyday household materials.

The desk study of the maps and their constituent areas were measured by taking the aerial view of the study area and was analyzed with descriptive statistics.

The analysis is based on the observations in the field done in a single day by a group of 5 people. In the field the data were collected by observation of the town area as well as the surrounding areas and also casual conversation with few of the people there.

Sustainability Parameters

Land Use Pattern

To get a comprehensive idea on the land use pattern of Bungmati, an area larger than the basic residential area of bungmati has been chosen. The land surrounding the bungmati's residential urban tissue is used for agriculture by the population of the town more towards the south and east. The Karyabinayak Temple acts as a barrier as well as a buffer between Khokana and Bungmati and restrict the activities of the residents' of bungmati to the North.

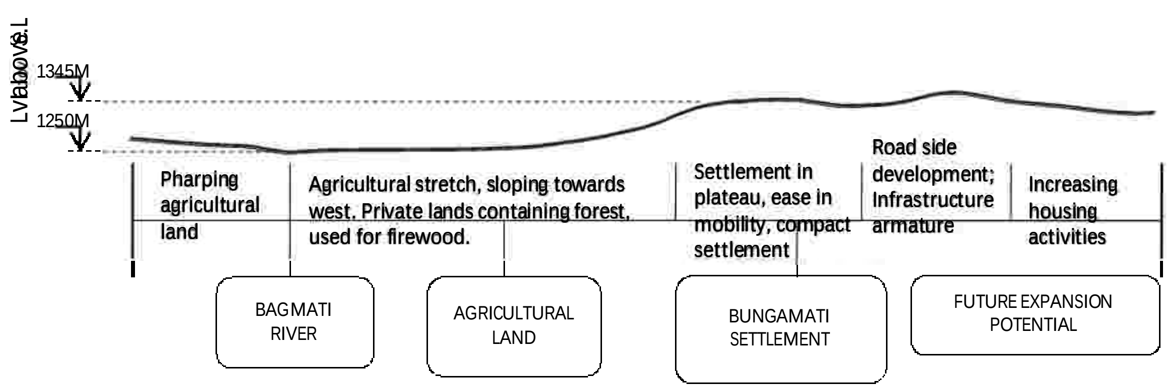


Figure 1 Land Profile of Bungmati

Like most Newari traditional settlements the people have inhabited the raised plateau section of the land and practice agriculture on the lower plains to receive convenient water supply for the crops. There is a steep slope demarcating the west of the settlement of bungmati whereas the other directions are comparatively gentle and towards the south. The steep slope towards the west is thoughtfully stabilized by the forest there which does not diminish with time. The plateau of land in which the residences are built is optimum for daily activities of the people without traversing much up and down, which would be laborious and tiresome.

The progression of aerial view of bungmati shows that there has not been much urban sprawl into and out of the town with built up space limited to the core city without breaching the

Figure 7 2003, Bungmati Area

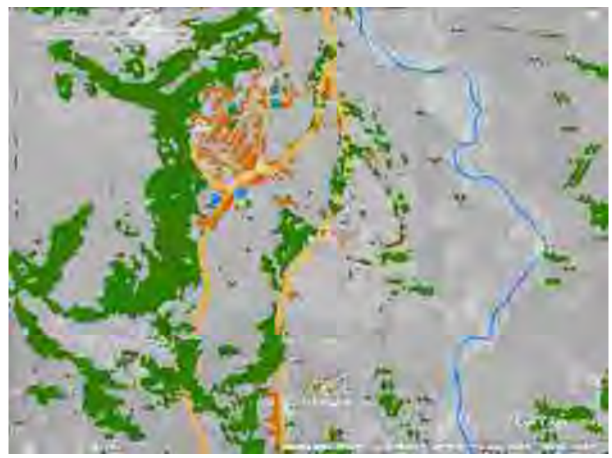


Figure 5 2004, Bungmati Area

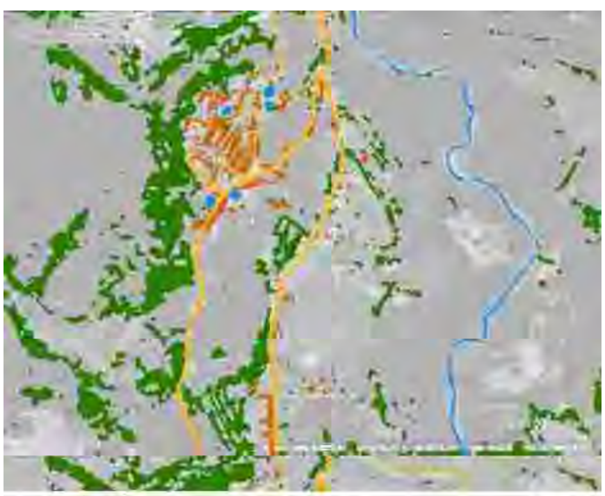


Figure 6 2007, Bungmati Area

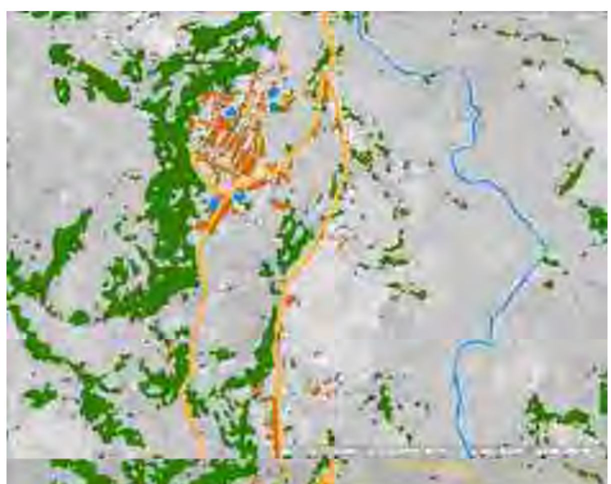


Figure 4 2009, Bungmati Area

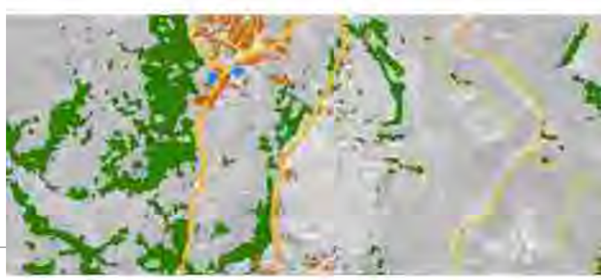
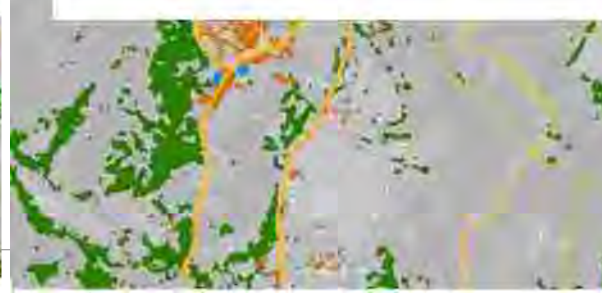


Figure 3 2011, Bungmati Area



boundary of the city.

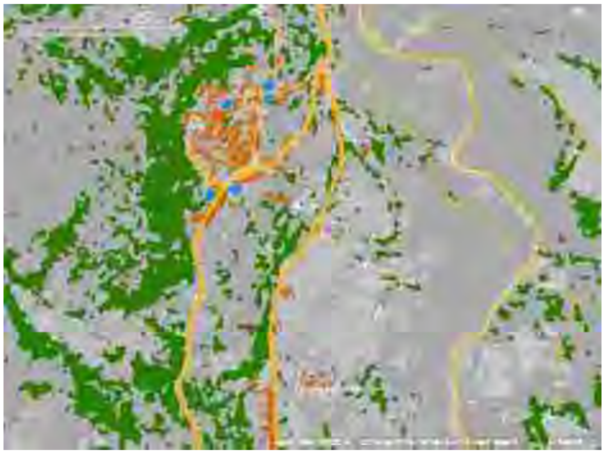


Figure 11 2012, Bungmati Area

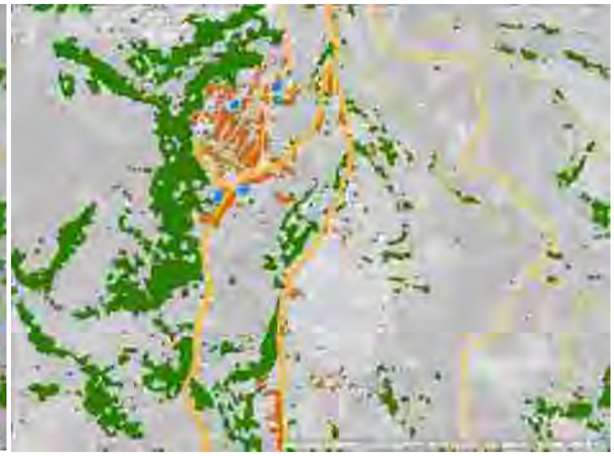


Figure 10 2013, Bungmati Area

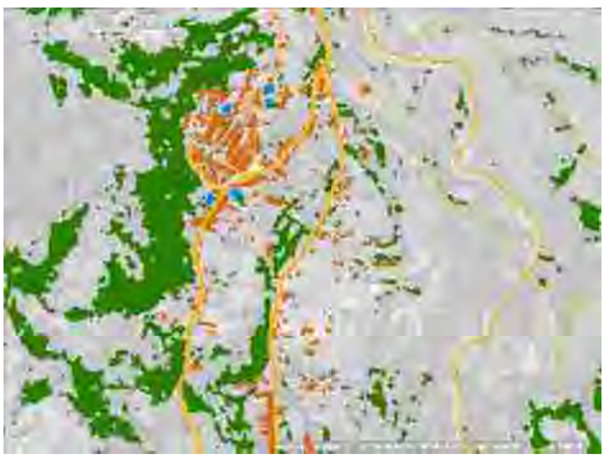


Figure 9 2014, Bungmati Area

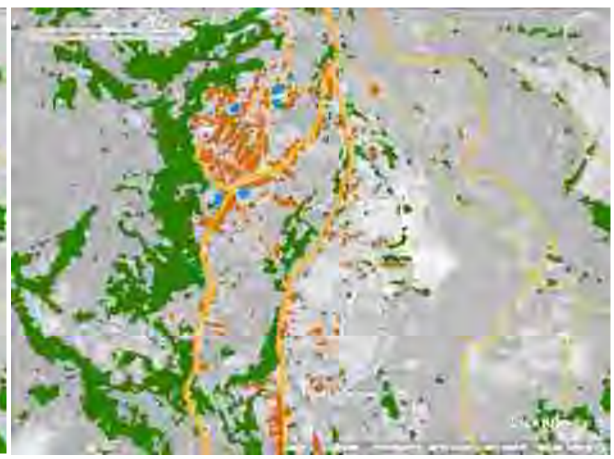
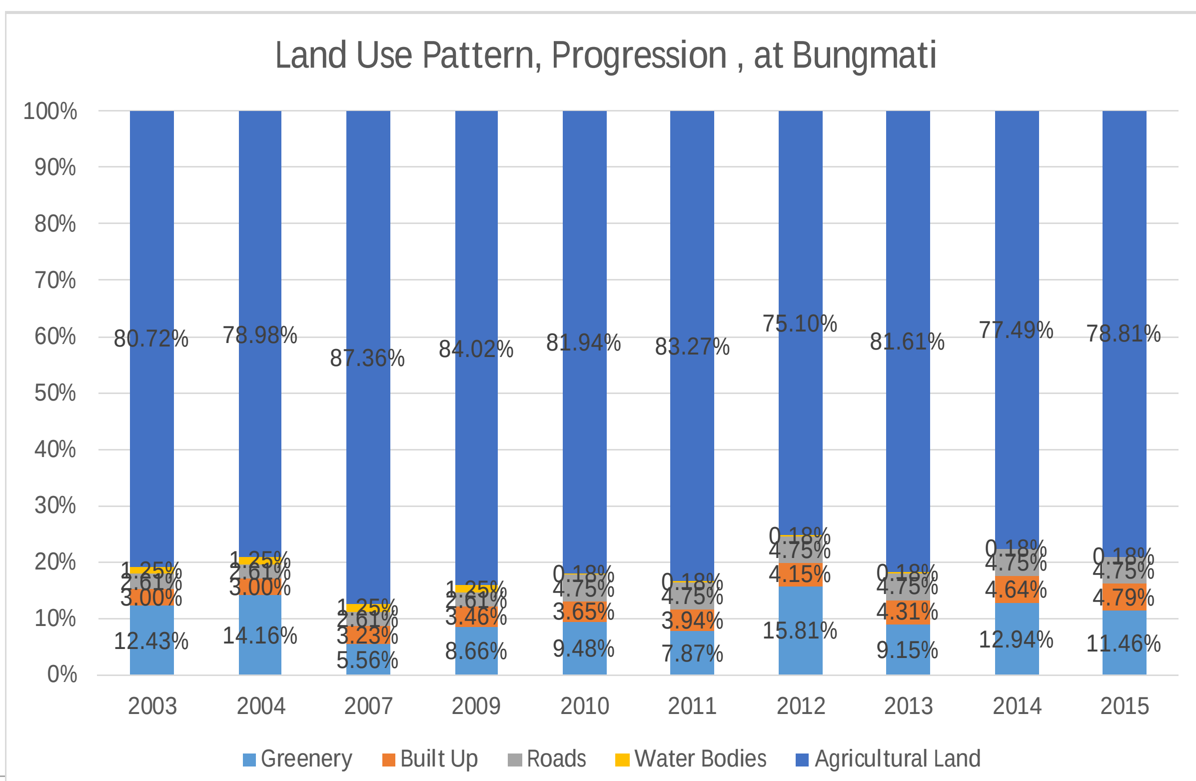


Figure 8 2015, Bungmati Area



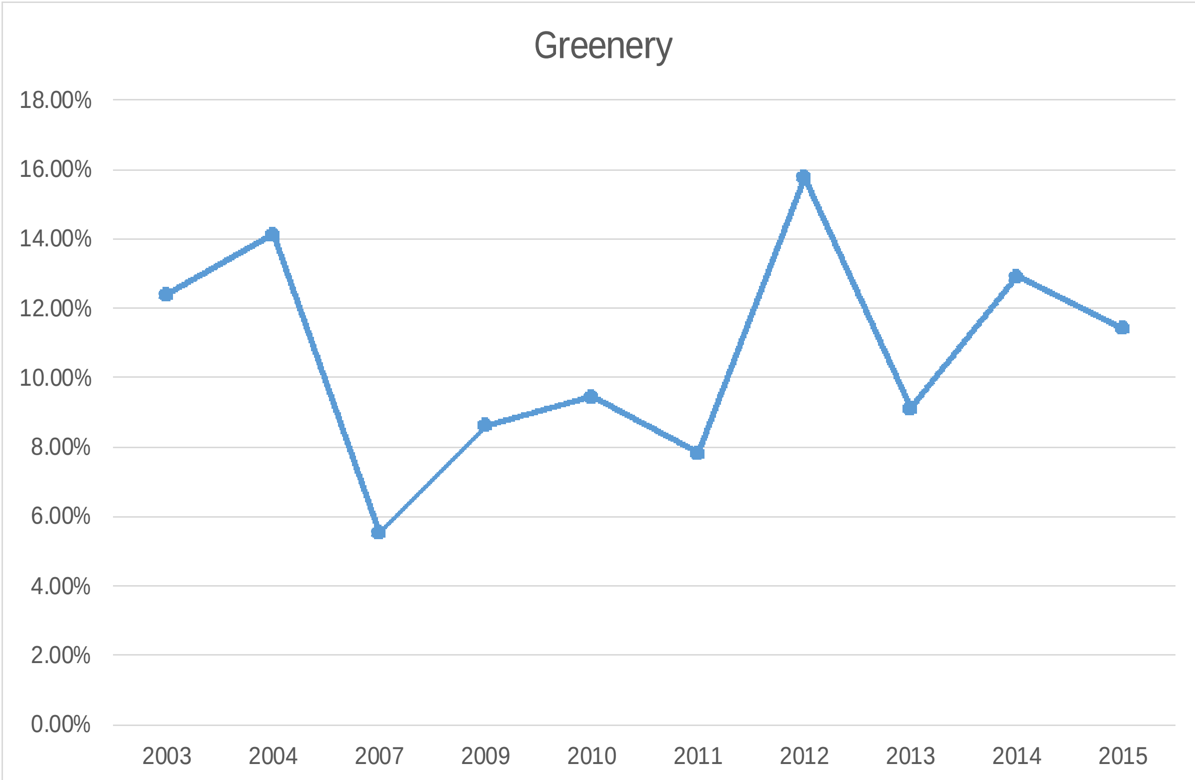


Figure 13 Amount of Greenery from 2003-2015

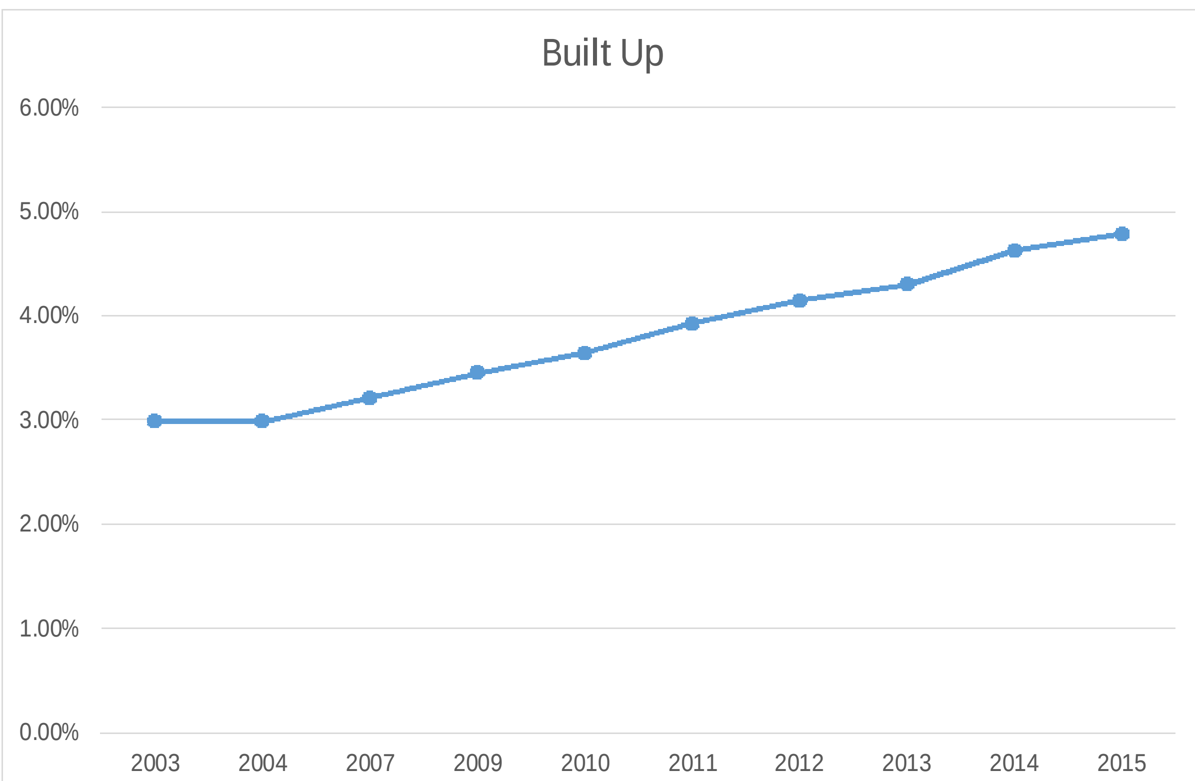


Figure 12 Built Up Area in and around Bungmati from 2003-2015

The amount of greenery is seen fluctuating up and down with lowest in 2007 and highest just recently in 2012. The reason might be that the forest near karyabinak is community based and some even are private forest which produces biomass in form of cooking fuel to the community at bungmati.

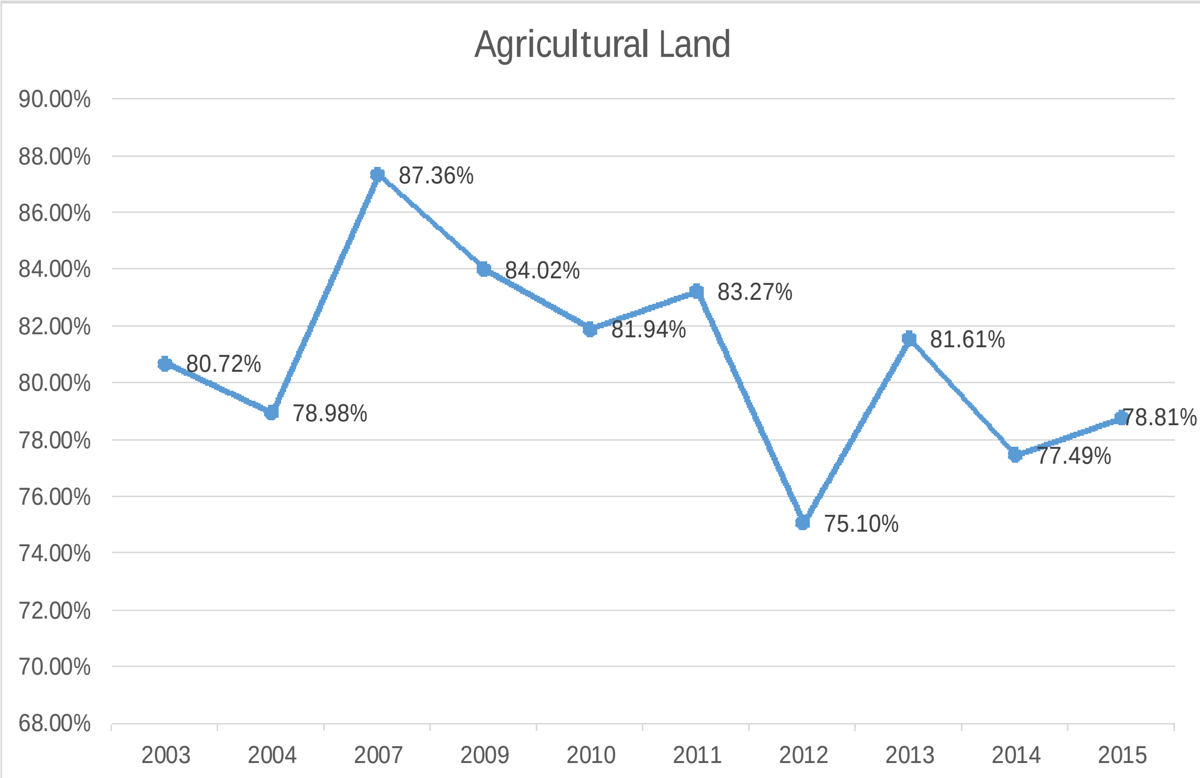
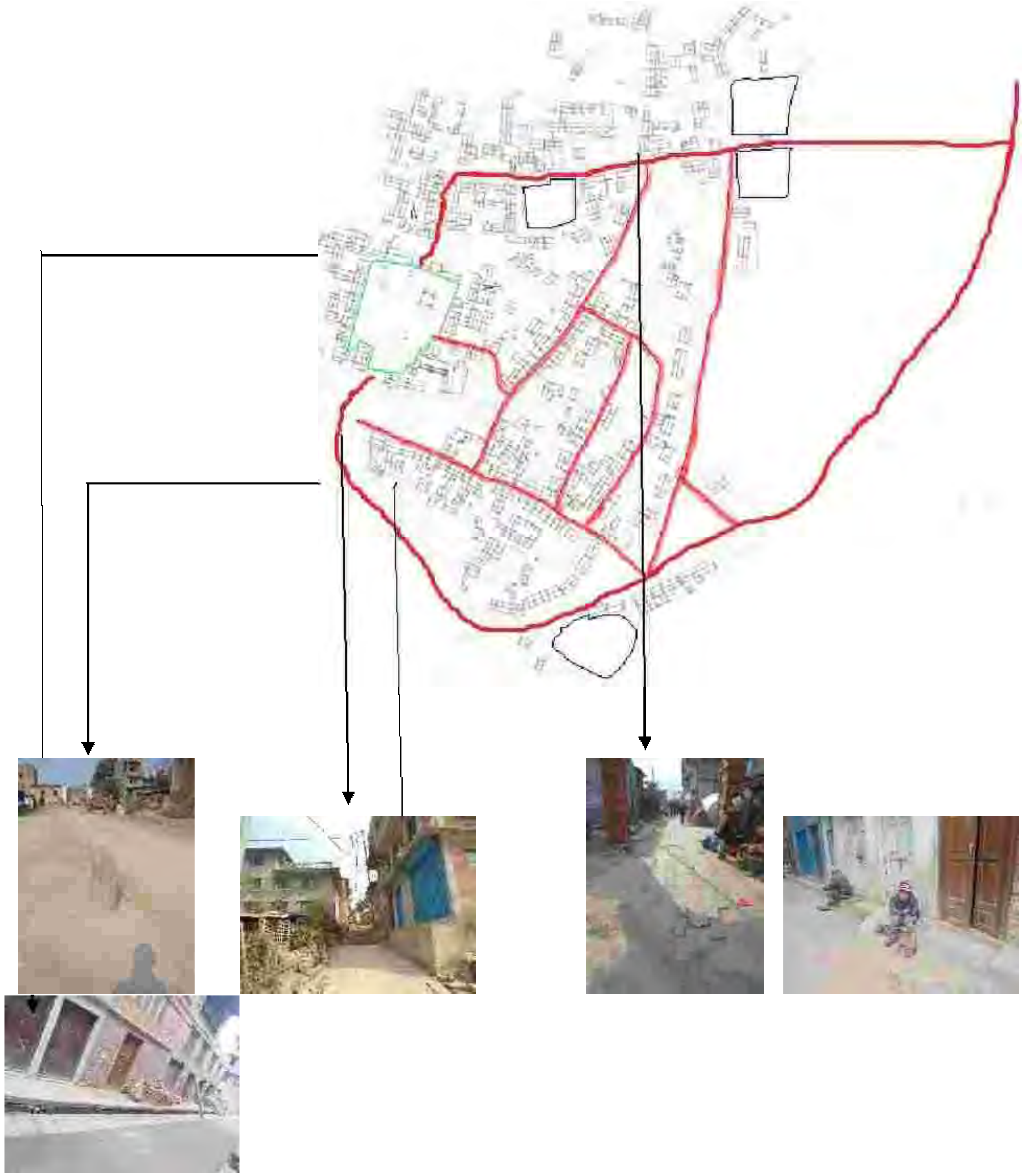


Figure 14 Percentage of Agricultural Land in the Bungmati area and Surrounding

The main occupation of the people there is agriculture so it is no wonder that so much area of land is used for farming. This area shown in the figure represents all the vacant plots of land that can be seen in the area view above. Some plotting of land is seen to be done between 2011 and 2012 in the south of the town which seems to disappear in a year or so.

Even though the river to the east seems to have disappeared, the urban sprawl is limited in the core area, town on bungmati, only and the growth of built spaces is evident but only feebly and the quantity or area of green areas are almost constant as well as the population of the town which indicates that the town is sustainable in terms of land use pattern.

TRANSPORTATION SYSTEM IN BUNGAMATI



Mode of Transportation

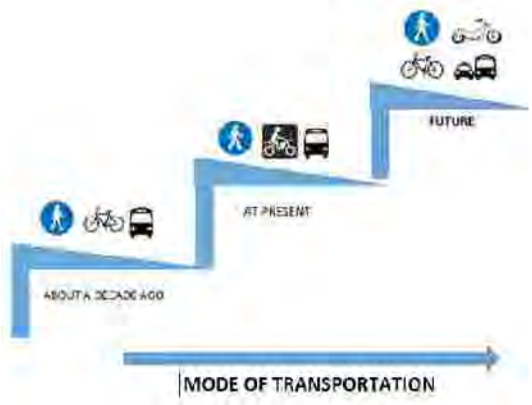


Figure 15: Change in mode of transportation

The transportation system is one of the integral part of the city. The system has been highly characterized by the socio-economic structure of Bungamati. At present the choice of mode includes Pedestrian, Public Vehicles and motorbikes. The routes in the settlements are pedestrian friendly with a definite purpose of fulfilling all the basic services, sociocultural rituals as well as maintaining the linkages with the neighboring lands. As all the services, temples, public water tap……. are available within the walkable distance padestrian is the dominating mode. In other hand the local police officer also stated that the security is athentic and no any crimal activities has been witnessed so far. Thus these scenarios are all very much supportive for the pedestrian locality.

Public Transportation is the governing mode for the inter connection of Bungamati with other cities. Bungamati has an old bus park with the parking area capable for about 20 buses. The major routes covered are Bungamati-Jwalakhel and Bungamati-Ratnapark. However due to the current fuel shortage their number of trips made per day is about 5:1 ratio. The service availability begins from about 5:30 a.m and terminates at about 7:30 p.m each day. The headway between the two ariving Buses is about 20 minutes. The density of passenger is very high at office hours and early morning college hour. Infact about 75% of the total passengers at morning are students. Apart from this routine travel pattern, density of passenger is tremendiously high at the festive season. Similiarly motorbike is other preferred mode. Cycles used to be one of the dominating mode used, about a decade ago. however at present it has been replaced by motorcycle. This is the present scenario of transportation system in Bungamati. Upto the date the system is sustainable with pedestrian and public as major mode however there there are many factors influencing this system.

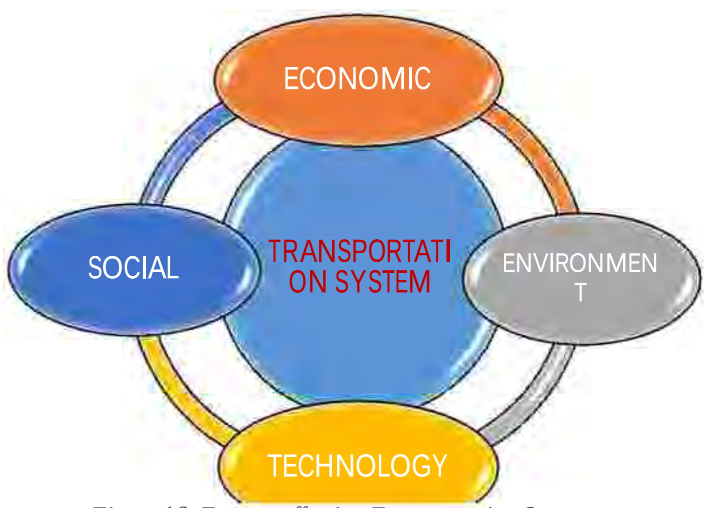


Figure 16: Factors affecting Transportation System

Transportation dynamism of bungamati:

The factors affecting the transportation system at Bungamati can be classified as follows;

Economic: The major economic activities prevalent in this area is agriculture, wood carpentry and carving, Tourism, Carpet manufacturer, Service etc. The function of these activities takes place in domestic level and very less external access mobility is required. It was observed that most of the female worked in the agricultural field and men were engaged at wood carving works. The working and earning activities are all carried out within the walkable distance of Bungamati area. Only occasional trips are made out of the city especially for importing wood and other materials from patan because of which transportation system is sustainable at present as there is no much requirement for travel. However the economic tendencies of present generation is likely to make a great deal of intervention. From the interview of the locals it was known that the number of youths of Bungamati engaged in agriculture or wood carving is very low as compared to previous generation. We cannot ignore the occupational paradigm shift from agriculture and wood carving in the city to service oriented occupation out of the. This moderation in the choice of employment is leading to the change in mode of transportation; from pedestrian to public mode and Private vehicle which is definitely threatening the sustainability aspect of the Transportation system in Bungamati.

Social: As discussed above, Bungamati is a satellite city/village which is self-reliant for its general requirements however for the fulfilment of advance requirements such as health facilities, higher education, trade etc. Patan is its mother city. Thus the major transportation transaction is made over this particular route. As the area is historically important and preserved one, these are very important cultural and religious route. During the carnival period there is massive interference in transportation system. Meanwhile by virtue of the rich culture and tradition in this Newar society and the communal connection among the people in the city and also with the adjacent city like khokana, interaction among the people has always been prevalent thus this particular scenario is very much supportive for the sustainability of the transportation system as it promotes pedestranization. However with the devastating earthquake that ruined more than 85% of the houses now people have setup their temporary shelter in the field in very scattered manner, if revitalization of the area is delayed then there are chances for the extinction of this communal relational amongst the people, perhaps like in the modern society people will start seeking for privacy which could threaten the sustainability aspect. Similarly with the advancement of society and increasing demand of better education, health facilities and employment opportunity of self-interest, the locomotor movement pattern has changed from within the city to inter cities which indeed increases the demand of the modes other than pedestrian.

Figure 17 : Locals at interaction

Technology: Today modern society is making tremendous advancement in technology. In case of Bungamati, no technological influence has been witnessed so far. However adequate intervention of technology in the system can definitely lead to sustainability. One of the way is by introducing sustainable modes practices like replacing motorbikes by electrical vehicles or restoring the bicycle culture. Similarly technology in the economic sector is mandatory for the present scenario. For instance, the agriculture is very much labour intensive because of which it is losing its attraction in today's generation. Unless technology is introduced, maintaining the agriculture as prior occupation is very complex and so is it in the case of woodcarving. If technology is introduced in these domestic economic system then the current generation will possibly flourish it forward and maintain the self- reliant city because of which the massive trip in and off the Bungamati can be controlled and the sustainable mode of transport can be efficiently adopted. Technology can make the city much more convenient however it's over implication could lead to the hazard in historical and cultural aspect of this site.

Environment: Transportation system and Environment both has mutual effect on one other. A radiant pollution less environment facilitates user to adopt sustainable modes such as pedestal and bicycle. In other hand mode of transportation ought to be eco-friendly. When environment is concerned, it is very important to observe the development status of the adjacent sites and cities. In case of Bungamati the transportation System is greatly influenced by the travel pattern and choice of mode selection by Population of Vaisepati area, as these areas share the travel route. From the survey of travel style of vaisepati area, it was observed that the mode choice is very much inclined to private as compared to public mode. This choice is indeed not so impressive if sustainability is considered. This tendency is leading to traffic congestion over the Bungamati-Ekantakuna route. A part from this vaisepati is loaded with private lands, there are numerous rising construction companies looking forward for the market to enhance their business. Construction of building colonies is setting its racing pace. With the prevalent convenient environment vaisepati has represented itself as one of the appropriate zone for residential purpose. At present scenario, what we can see is the population group who are employed abroad when return back prefer sticking to urban area rather than settling to the respective village because of their habit of life fully governed by technology. This way Vaisepati has become one of the attractive spot for the residential purpose. With this short time extensive densification of Vaisepati area, the transportation system is likely to get disturbed, the current system will definitely not be able to cope up with the requirements, both in terms of quality and quantity of mode leading to more energy consumption, lack of parking Ares, environmental pollution, and inaccessibility and so on. Thus an efficient transportation system planning is required in order to address the possible paradox.

Figure 18 Expanding Settlement of Vaisepati area

Water Supply

Figure 19: Bungmati Pump House

The water requirement in Bungamati area includes mainly of four categories; Drinking purpose, Cattle water demand, basic domestic uses such as , washing, cleaning etc , agriculture and traditional ritual requirements. Bungamati gets its portable water from Jwalakhel Drinking water limited which indeed is from pharping water Supply. There is a Bungmati pump house from where water is pumped to the several public water distribution junctions of the area.

Water grid system connection has not been setup at this area yet. Thus Public tap is the source of portable water.

Figure 2: Public Tap

This is also an important part of the social life that contributes for the sustainability of the city. From the interview of the locals it was known that the water supplied in this area is not adequate enough to fulfill the requirement of the people. They are making great deal of compromise. Water is available only one or two times per week and it's not done with ease, a lot of time is consumed in pending period and there are occasional dispute among the people due to scarcity.

For the other external purposes like cleaning, washing etc, it is supplemented from the community ponds. There are five ponds in the Bungamati area, out of which two ponds possess qualitative water which is used for the domestic purpose. Other two are comparatively with more turbidity and full of aquatic plants like algae so there are now under the possession of ducks and other cattle. One has dried up due to some construction process which is now made available for the recharge. Thus because of these scarcity, Nakkhu khola has been used as an alternative site for washing and cleaning whenever abundant work is required. The present water supply scenario of the area is not so impressive. As an old traditional settlement and a city comprising several eco-city features, there is adequate water for the domestic animals and for maintaining certain ecological water contentment of the area. In contrary the water content has gradually decreased as compared to the past. Perhaps with increasing population, the per capita demand has not been addressed properly. People are highly unsatisfied with the water supply status of the Bungamati area. Despite all these scarce issues no much attention has been given to the possibility such as water harvesting.

Figure 20: Five Ponds of Bungmati

The other source of the water is underground water. There are several private and public well in this area. Fortunately the groundwater extraction has not been done in extensive manner which is very good from the sustainability point of view. However some of the traditional well dried up about a decade ago. This clearly says that the water sustainability is at threat. Ground water has mostly been used for the economic purpose. There are several carpet manufacturing company that uses well water for the carpet works. Similarly the area of water requirement is for the traditional and cultural purposes. There are several other water entities that plays vital role in the advancement of these ritual procedures. Similarly the agricultural requirement is managed by the grey water from the residential networks connecting all the open and close drainage and canals leading to the field. The fields are also simultaneously irrigated from the water that is channelized to the field from the Tikabhairab. Viewing overall water supply scenario; the scarcity of water and the dispute caused by it in the socio-economic life of people the sustainability aspect is lacking in consideration of water.

Solid waste Management:

The solid waste management on the bungmati area is mixed type. As the area has recently been included in municipality, the solid waste collection from municipality is in its infant stage. The collection is made only from the surficial boundary of the bungmati area however no collection has been made from the core area. Intact moving out of core area for the submission of garbage is not convenient for the people thus munciple garbage collection has not been effective. From the literature review the solid waste trajectory route is known as in the figure however it represents only the case of few number of resident. The solid waste management of core area includes both composting and direct disposal however composting is prevalent in very less number of residents. The organic residue from the kitchen are composted at domestic level. Traditionally there used to be allocated areas exclusively for the composting activities called Sa:Ga. But there seems to be very less sign of such provision at these days. Only

Figure 22: Waste Trajectory ***Invalid source specified.***

Figure 23: Home Composting of organic garbage

Figure 21: Solid waste disposed at the end of city

few number of residents have composted the organic matter from the agriculture and kitchen residue.Especially after the devastating earthquake these vacant areas has been occupied by temporary shelter. Meanwhile in the random temporary settlement of the people, the management of solid has rather been neglected. Though the garbage from many resident is incinerated yet solid waste was witnessed to be randomly disposed in the open drainage and gutters. Apart from this massive amount of solid waste is recklessly disposed over the hinterland off the cliff. The garbage were not visible due to the simultaneous disposal of the debris from the damaged houses however the air quality at the place was extremely poor. The solid management of Bungamati area is very feeble in fact it is not sustainable at all. Even more as an agricultural area solid waste has been least utilized and neglected to such an extent that it's leading health hazard and environment degradation.

Energy

Energy is one of the important and daily requirements of the people for livelihood. Importance of energy is well understood from the current energy crisis. In Nepal, overall energy resources as categorized by the Government of Nepal is into three types viz. Traditional, Commercial and Renewable resources. Traditional energy Resources includes firewood, agricultural residues animal dried dung whereas commercial energy resources includes Liquid Petroleum Gas (LPG), Kerosene oil etc. The types of energy are available in the Bungamati area are solar energy, hydro energy agricultural residues which are renewable sources and firewood, fossil fuel, LPG gas are non-renewable sources of energy. The highly used energy sources in Bungamati are firewood, LPG for cooking and electricity for lighting. Energy used for the purpose of cooking, heating, lighting, irrigation and others.

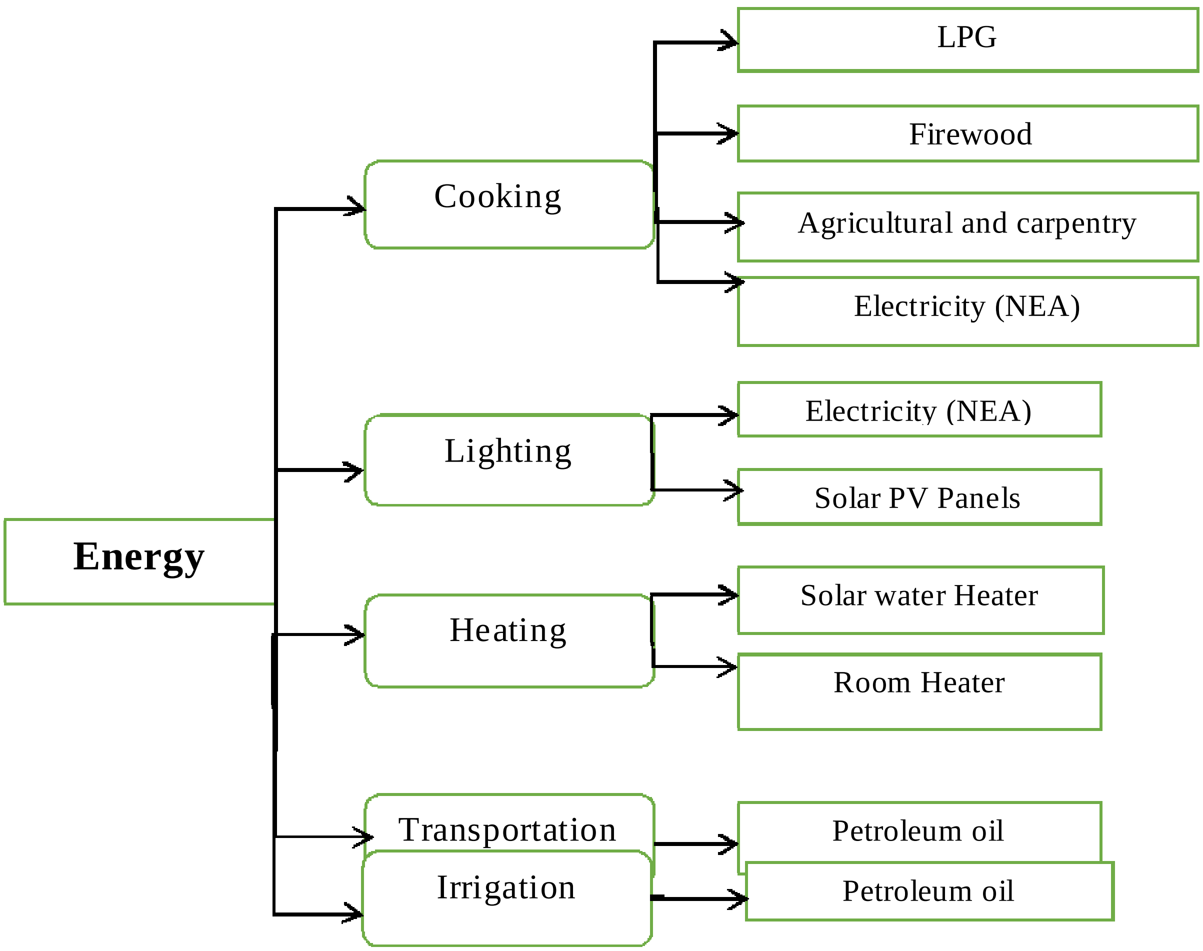


Fig1. Energy flow pattern and sources of energy used in Bungamati Area

Purposes of energy used

1. Cooking:

Cooking the foods kills the harmful germs and bacteria and makes the food healthy to eat. Sources of energy used for cooking in Bungamati are firewood, LPG, electricity, agricultural and carpentry residues. Among these firewood, agricultural residue such as maize stalk, “chwali”, rice straw were used for cooking in traditional cooking stoves in past. The pattern of cooking has been changed. Now, uses of LPG, electrical appliances, heaters are increased for cooking. The firewood is collected from private as well as from the community forest near by the core area. The people, who have not private forest, bought the firewood from the market. Some household used the firewood for producing the rice beer and for cooking huge amount of foods during festivals. For daily cooking, people used LPG as it is convenient in cooking process and takes less cooking time. During energy crisis, people used firewood and electric heater. The non-reusable woods from totally damaged houses by the earthquake are also used for cooking.

Fig.2 Firewood and Liquid Petroleum Gas

(LPG): Non-renewable sources of energy for cooking.

Traditional cooking stoves or “Chulo” is the device that is used for cooking and made out of mud and also use some sticks in order to give it support. Most of the people in Bungamati cooked food in traditional cooking stoves which has following drawbacks.

Drawbacks of Traditional Cooking Stoves:

- The thermal efficiency is low.
- Requirement of more firewood.
- Smoke is accumulated inside the kitchen, thus, creates indoor air pollution.

- In-convenient in cooking process and time consuming.
- More chances of fire hazard.
- Problems of respiratory diseases and eyes diseases.

To overcome from above drawbacks, Improved Cooking Stove is an alternative. ICS is a device that is designed to consume less firewood, save cooking time and convenient in cooking process. Potable and fixed installation Improved Cooking Stoves are available in Nepal. The people living in the temporary settlements do not want to install Improved Cooking Stoves. For them potable type ICS is suitable. Improved Cooking Stove is made from the local materials so cheap in installation. The cost of installation of ICS is about 300-400 NRs.

Benefits of Improved Cooking Stoves

Fig3. Improved Cooking Stoves in Nepal 50% fuel consumptions and no harmful emissions.

- The consumption of firewood is reduced by 50%.
- Increased thermal efficiency about 15% - 25%
- Conservation of forest as cutback in firewood consumption.
- Reduction in indoor air pollution.
- Reduction of cooking time and work load.
- Prevention from fire hazard as well as health hazards.
- Reduction in GHGs emissions.

An improved Cooking Stoves can even be used for space heating by adding a cast iron/ mild steel plate fixed tightly over the pot holes of the stoves or by using a metal chimney which radiates heat to the ambient temperature. (Improved Cook Stove, 2009)

2. Lighting:

The main source used for lighting the houses of Bungamati is electric power supplied by the NEA. As the problem of load shedding of 12 hours, the solar PV panels are seen to be mounted on the roof of some building and some building use electric inverter. Most of the houses were damaged during the earthquake so only few houses with solar PV panel are observed. The small Solar PV panels are installed for the purpose of lighting only. Solar Tuki that is distributed to the victims of earthquake by the international agency is used at the time of load shedding. The street lamps with solar PV panels are seemed mounted at the temple area. The electric materials used for lighting are CFL, electric bulb and tube lights. Among these, CFL is an energy efficiency material and use of energy from solar is a sustainable way for lighting.

Fig4. Carpentry work: Using an energy efficiency material i.e. CFL bulb.

3. Heating:

Buildings in the core area of Bungamati are traditional and some of the buildings at the bus park are modern. It is observed that only in the modern building, solar water heater systems are installed at the roof of the building and for the room heating room heaters are used. The thermal performance of traditional building is better than the modern building. From the field interviews, it is observed that no energy expenses for space heating in traditional building.

4. Transportation:

Transportation is one of the main infrastructure which is important for the mobility of the people and goods. Public bus services are available and the most preferred service by local people than the private service. Most of the houses have the facility of private vehicles i.e. motorcycles. The fossil fuel that is petroleum oils is consumed by these vehicles. Petroleum oil is the non-renewable source of energy.

Rising energy prices and environmental concerns have made energy conservation a high priority for transportation operations. Small size buses are available for public transportation. Large public buses rather than small buses and private cars should be used for the mobility of huge mass of people and goods at a time.

5. Irrigation:

Agriculture is the main occupation of people of the Bungamati. For the better agricultural production, irrigation system should be managed properly. To irrigate the agricultural land of Bungamati, water from the Bagmati River is pumped. For pumping water the pumping machines required energy. The energy used is either petroleum oils or electricity.

Field interview

Table: Field interview with people of traditional building

S.N.	Introduction	Electrical materials used	Expenses	
1	Ganesh Lal Tuladhar Age: 65 Occupation: Hotel shop Family Member: 6	Television: 1 CFL: 2 (Kitchen and passage) Tube light: 1 (bed) Fan: 1 Refrigerator: 1 Washing Machine: 1	Total unit/ month: 25 units Total charge/month: 200-300 NRs For cooking LPG: 2 cylinder/month	No solar PV Panel No solar water heating system
2	Ashok Paneju Age: 50 years Occupation: Priest of temple Family Member: 8	Television: 3 (1 LED) CFL: 2 Tube light: 2 Fan: 1 Computer: 1 Inverter: 1	Total charge/month: 300-400 NRs For cooking LPG: 1 cylinder/month	No solar PV Panel No solar water heating system
3	Nani Maya Maharjan Age: 36 years Occupation: Housewife	Television: 1 CFL: 2 Florescent bulb: 2 Water pumping machine: 1	Total charge/month: 200-250 NRs For cooking LPG: 1 cylinder/ 2 month	No solar PV Panel No solar water heating system

	Family Member: 4			

The field interviews with the local people of Bungamati are carried out and from the interviews above information about the energy is obtained. Both CFL and tube light are used. The expense of the electricity is within the range 200-400 NRs. People said that CFL bulb is expensive and gives less bright light than tube light. So, people used tube light in bed rooms and in Kitchen. For cooking purpose LPG and firewood is mostly used. Firewood from their own forest or community forest is collected. Some people buy the firewood at the rate of Rs.200 per bundle. During the energy crisis, use of firewood is high, due to shortage of LPG for cooking. In residential building about one cylinder per month and for commercial building two cylinders per month is required along with the use of firewood. Solar PV system and solar water heating system are not installed due to expensive technology.

Energy Scenario

S.N	Energy sources	Types of energy	Types of energy source
1	Forest	Firewood	Non-renewable
2	Running river water	Electricity	Renewable
3	Sun	Solar	Renewable
4	Crude fossil Fuel	Petroleum oil	Non-renewable
5	Natural gas	LPG	Non-renewable

The major energy resource base in Bungamati consists of biomass, hydroelectricity, petroleum products, natural gas. Firewood is major source of energy. In the context of Nepal, forest is a non-renewable source of energy. After cut down the trees, no plantation of trees is done. Continuously, extraction of firewood from the forest may lead to extinction of the forest in Bungamati. Each year the forest area is decreasing and converting forest land into cultivation and settlement land. Improved cooking stoves have the potential to save the firewood used for household cooking. It is possible to reduce firewood consumption for cooking.by 50%. Traditional Cooking stoves should be changed into improved cooking stoves.

Similarly, fossil fuel and natural gas are also non-renewable sources of energy. The dependency on the LPG and fossil fuel is growing day by day. All the fossil fuels consumed are imported in refined form for the direct consumption. The alternative fossil fuel, natural gas, has not been discovered as yet in any significant amount. (Present energy Senario in Nepal, 2005) Hydro power is the renewable source of energy. Nepal has high potential for hydropower production. The hydropower potential of Nepal's river systems is about 83,000 MW, out of which only 25% is potentially available for development. The national grid represents the overall hydroelectric industry of Nepal. NEA has distributed the electricity all over the Bungamati area. Solar Energy is also a renewable and sustainable source. The solar energy potential in Nepal is estimated to be about 26 million MW. (Present energy Senario in Nepal, 2005). Very few building has installed solar PV systems and solar water heater because of high cost and technology is too expensive for most people of Bungamati. The government of Nepal should make the policies about the subsidy for solar PV systems to encourage people.

By using the energy from the renewable sources, sustainability in energy can be achieved. Replacing the traditional practices like traditional cook stove by improved cooking stoves, using energy efficiency devices, sustainability in energy can be achieve to some extent.

Sewage management

For the sewage management, water carriage system is managed throughout the Bungamati area. For this sewage management, huge quantity of water is required. The water required for water carriage system obtained from shallow wells. Sewer pipeline is layout under the core area of Bungamati. The sewage of this area is directly disposed to the Bagmati River without treatment. Direct disposal of sewage have polluted the Bagmati River.

Fig1. Drainage systems for disposal of grey water and rain water

There is provision of drainage to drain the rain water and grey water. The grey water is used to irrigate the agricultural land near to the core area of Bungamati. Two types of drainage facilities are available: open drain and closed drain. There is open water system. Neither black Water nor grey water is treated for reuse of water. The grey water is reuse for recharging the" Kulos". The water from "kulos" is used to irrigate the agricultural land.

No regular maintenance of drainages. The closed drainage has been converted into open drain. The drainages are clogged by the solid wastes especially plastic wastes. No regular and proper maintenance of drainages. From the fig. it is observed that the present drainage system is not sufficient and problem of leakages. Temporary latrine are constructed for the temporary settlements. The leakages of drains and clogged drains have polluted the environment of Bungamati. In other hand such negligence has ruined aesthetic beauty of the city which is not an ignorable fact for a historically important area like Bungamati. The sewage management of the Bungamati is very unsustainable.

Fig2. Lack of maintenance of drainage system

Infrastructure:
Infrastructure pertains to systematic provision of essentials required for operation of a territory, through planned service network. Human activities and functions would be impossible without facilitation of infrastructures.

It can broadly be classified into two categories:

- **Physical infrastructure**
    - Road network
    - Water supply
    - Electricity
    - Sewerage
    - Irrigation channels
- **Socio-cultural infrastructure**
    - Temple
    - Open spaces
    - Paati
    - Pond
    - Library
    - School
    - Economical
    - Weaving
    - Carpentry
    - Shops with Daily essentials
    - Commerce and banking

Physical infrastructure for traditional Bungamati was structured to provided for settlement functioning and for agriculture. As a result, streets with connected drainage system, water infrastructure and irrigation channels were built. Wells and ponds fulfilled for water demands. Social and cultural infrastructures built then were temples, open shrines, community buildings (*Guthi)*, resting/sitting sheds *(Pati)*, and open spaces including ponds. Recent development has lead to ingress of electricity, water supply, sewerage and communication infrastructure. Telephone line, cable network lines run along the road side metal-pole-network.

Road Network:
Bungamati road network presents traditional Newari street characteristics. It can be categorized with respect to their physical characteristics, and its use for socio-cultural activities. Different kinds of road existed in this settlement which varied with their service usage. Traditional road used to be paved in stone and consisted of road-side drain (surface/subsurface). The width of road ranged from 1m; between houses, to 6m; at road junctions. Road connecting city center, through Bhaisepati, is bitumen topped. It is consists of underground services running along with it. Main water supply pipe-grid, electricity supply line consisting of transformers, communication lines (telephone, cable network) are located in proximity of this service armature.

The narrow, stone paved street, occasionally consisting of stairs is suitable for walking conditions and not designed to accommodate vehicular movement. Internal streets of settlement are well connected to the perimeter road network. Roaming around the settlement for a full working day, during our field study, didn't make us feel tired. This compact form of settlement is pedestrian friendly and zones out vehicular movement to its core. However, present living conditions possess vehicle friendly streets. The main trunk line serves the purpose of providing transit facilities with buses connecting city center. The buspark area consists of wide streets which have been accommodating parking of vehicles. The core settlement was not designed to facilitate vehicular movement. Hence there is no provision of parking in the core. Recent development has lead to infiltration of bikes in the streets; reduced number of cycle users is another consequence of this shift of travel mode.

Road network was categorized as following:

- Main Trunk Line
    - Metalled road with width of 8m
    - Connects city center through Bhaisepati
    - Serves as primary route for vehicular movement
    - Water supply line, electricity grid, drainage pipe and cable services along this road
- Main Street
    - Traditional road characteristics with road width 5-8m
    - Accommodates vehicular movement within settlement
- Secondary Street
    - Settlement's mobility and service artery
    - Residential street characteristics with narrow streets with width 2-5m
    - Contains stairs at places

    - Extension of residential external functions
- Foot Trails
    - Trail accommodating movement of human and motor-bikes
    - Leads to individual resident and through agricultural land

Agricultural Land Use

Agriculture is the main socio-cultural activity of Bungamati. The very history of Bungamati, which originates from the mythical story of *Bunga dyo* (Rain god), is the worshipping for and celebration of rain that comes for agriculture. Agriculture has been intertwined with every cultural, social, economical and environmental system that runs in and around Bungamati.

Topographically the Settlement of Bungamati is situated on the plateau with valleys of agricultural farmland on both sides. The rivers, Baghmati on the west and Nakhkhu on the east run along these large agricultural valleys. Since the settlement is historically very old and important one, the hereditary agricultural land of the inhabitants are scattered in very wide range of these valleys. Unlike Kathmandu valley, these lands are stilled preserved and less encroached, which might be due to following facts:

- Topographically low lands
- Socio-Cultural integrity of Agriculture
- Sole Economic activity in the past days
- Abundance of water for irrigation from rivers and rainwater

Present Scenario

In the present days, still many of the families have agriculture as their main occupation and most of the families depend on their own agricultural activities for their consumption. But since later development and the weathering of socio-cultural values and practices, agriculture has been evolving more as an economic activity with low output and the interest of the new generation growing weaker. From interviews done with the locals following facts have been extracted:

- All of the interviewees use chemical fertilizers since past 5-6 years (at 1:5 v/v ratio of seed to fertilizer for paddy)
- Animal Husbandry and organic waste composting used to be main fertilizer source in past days
- Animal husbandry decreased with tourism development
- Use of human labor is getting costlier (500 NRs per day 10 am- 5 pm)
- Use of mechanized system (i.e. tractor, trailers, thrasher etc.) has been replacing human labor
- Only few of the interviewees have to buy crop product for 4-5 months supply
- Annual crop rotation is in practice (Paddy-Wheat/Potato/Mustard-Maze-Paddy)
- Second major crop is decreasing due to lack of irrigation
- Brick kiln, Land pooling, organic farming green houses etc. are threat to traditional agricultural land
- Many interviewees had farm lands at further than walking distance (transportation is a problem, potato rote in field during EQ)

Issues

1. **Chemical Fertilizers:** The rapid increase in the use of chemical fertilizers (Urea N46% often mixed with Sulfate of potash) has many unsustainable consequences, which affect soil characteristics and damage the quality of soil in the long term. To check such practice alternative should be sought out.
2. **Energy efficiency of Mechanical equipment:** The mechanical equipment used mostly the diesel powered combustion engines to draw tractor, trailer etc. need to have energy efficiency improvement and environmental emission control policies
3. **Agricultural land encroachment:** The agricultural lands with road infrastructure at reach are highly vulnerable to land use change. Recent land pooling and Brick kiln establishment suggest that they have potential of changing to high economic activity. To sustain the ecological balance provided by agricultural land, these changes need to be well planned.
4. **Irrigation:** The lack of sufficient irrigation infrastructure, which is in turn demoralizing the current farmers and new generation, need to be addressed.
5. **Transportation:** The lack of proper transportation is challenge to those with distant farms.
6. **Economic-Environmental balance:** The recent trend of agricultural practice as economical activity and disinterest of the new generation on continuing that suggest that the future developments in the Agricultural land use areas will be less ecologically sustainable than Agriculture itself. Agriculture as the major measure to achieve environmental sustainability can be useful in the context of Bungamati. For that intervention at large scale to improve economic-environmental balance of the whole area and preserve socio-cultural integration of agriculture in life of people from Bungamati should be carried out.

Conclusion and Recommendations

Land Use Pattern seems to have a sustainable approach with a maintained balance between forests, agricultural land and built up areas however the south of bungmati is slowly being filled up with built areas which need to be in check by making policy constraining to the minimum use of agricultural land for constructing buildings.

Transportation system in Bungmati is currently sustainable but however it is under constant threat. It is not an independent system there are social, economic, technological and environment aspect governing it. Moderation in any one of these aspect of Bungmati as well as its adjacent sites shifts the sustainability alignment of the area.

Thus in order to maintain this sustainability Bungmati has to maintain its economically self-reliant aspect so that the major activities take place within the city's walkable area. Similarly the motorbikes can be replaced by more energy efficient electrical vehicles. Certain level of technology should be introduced so that the present generation get interested in the activities of this traditional so that its sustainable aspect can be preserved. In other hand an appropriate policies and strategies for the system has to be formulated considering the overall development scenario of the neighbor settlement. This should be done with participatory approach including the feedback from every level.

Hard infrastructures, i.e. buildings, roads and services are improving in due development process. Existing form and characteristics of building and cultural heritage are being replaced by new ones, which do not comply with historical roots of Bungamati civilization. These alterations in settlement not only have alteration in built environment, but also consequences in ecosystem, i.e existing vegetation, natural environment and water recharge system. In regards to soft infrastructure, socio-cultural circumstances have also degenerated to certain extent. Casual conversations with elderly in regards to passing-on of traditional values and practices in new generations depicts before mentioned scenario. Social activities and cultural proceedings are, as of yet, in practice. Passing of these practices is channeled from family to siblings.

Sustainable practices need to be adhered while planning infrastructures. Symbiosis with existing environment and water system is integral. Ground water recharge, maintenance and upgrading of pond is recommended. Street networks and open spaces should be water permeable. Housing reconstruction is best practiced if traditional construction technique is improved with modern engineering expertise. Rebuilding of this cultural heritage site including the temple square, Machhendra Bahal, requires care in architectural conservation practices.

The huge importance of Agriculture, socially, culturally and economically has been found to be deteriorating with the many changes in life style to agricultural practices itself. The main component of sustainability of the historic settlement needs to be looked at carefully and supported through strategically infrastructure development to stop haphazard land use change and disinterest of new generation. Since it holds clue to maintain ecological balance in and around the settlement, the following recommendations are made:

- Agriculture integrated animal husbandry at large scale to help reduce the chemical fertilizer use
- Energy efficiency in mechanized practices through policies
- Strategic infrastructure development and compact settlement extension
- Preservation of agricultural land near the entry ponds through restriction policy
- Large scale irrigation project from Bagmati can be done including Khokana
- Incentives on farmers transportation fare to their distant farm

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Tribhuvan University
Institute of Engineering
Department of Architecture and Urban Planning
M.Sc. In Energy for Sustainable Social Development

Core course 2
Sustainable Energy for Urban and Rural Planning

GROUP SEMINAR PRESENTATION

March 18 2016

A sustainability assessment of a traditional settlement-KHOKANA

Presented by-

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INTRODUCTION

INTRODUCTION

Historical Background of khokana

Fig: Outskirt of Khokana

Fig: Karyabinayak Temple

- Established during the period of king Amar Malla in 15th century
- Was named as Jitapur after the name of Jitapur Mandapa
- First city to use electric light
- An ancient industrial town famous for its mustard oil

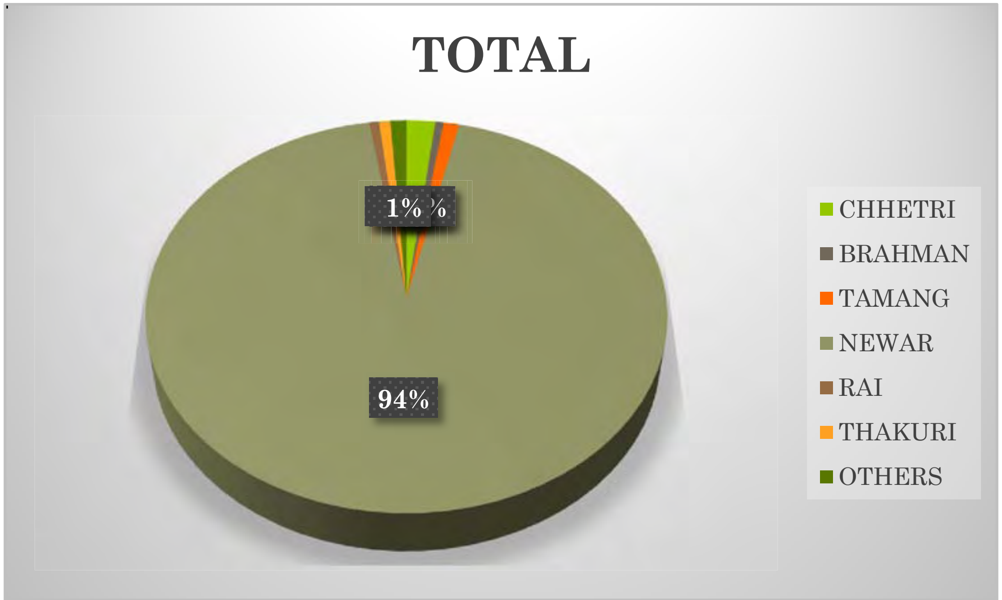
Physical Characteristics

- **Area: 3.17 sq.km**
- **Location**
  - 6/7 kilometers from Kathmandu city
  - southwest part of the Lalitpur
  - 6km from Jawalakhel

- **Population** (from 2011 Census)
  - Total Population: 4927
  - Total individual household: 1027
  - Density- **1554.4 inh./sq.km**

- Around 94% the Newar ethnic group reside in Khokana.
  - Mostly Maharjans- *Jyapu* (farmer)

MUNICIPALITYAND MOTHER TONGUES	TOTAL	MALE	FEMALE
ALL MOTHER TONGUES	4927	2452	2475
NEPALI	316	159	157
TAMANG	196	105	91
NEWAR	4364	2159	2205
MAGAR	13	8	5
OTHERS	38	21	17



Economic Characteristics

- Mostly involved in agriculture.
- Women involved in weaving, wool works,
- Making straw mat, carpets- Recycle of agricultural waste- ecological sound economic activities
- Metal statues production
- Mustard oil production- locally harvested

OBJECTIVE OF THE STUDY

- To analyze the elements and practices of the settlement" KHOKANA" in terms of sustainability.

- To assess the settlement pattern and land use on the basis of existing physical infrastructure for analyzing its social sustainability

- To assess the energy consumption pattern, solid waste management of the town and its impact on the environment.

FRAMEWORK OF STUDY

STUDY METHODOLOGY: Exploratory and Descriptive

LITERATURE

OBSERVATION: Interviews, Sketches, Photographs

Historical Background

Physical Characteristics

Socio-cultural Characteristics

Economical Characteristics

ANAYLSIS PARAMETER:

- Land use
    - Built form- residence
    - Open Space- Chowk, Streets, temples, agricultural land, river
    - Water bodies- Pond, Well, Hiti
- Infrastructure- Water supply, waste management
- Transportation
- Energy – electricity, renewable energy, passive design, energy efficient technology

CONCLUSION: Present Scenario and Future Potential for Sustainability

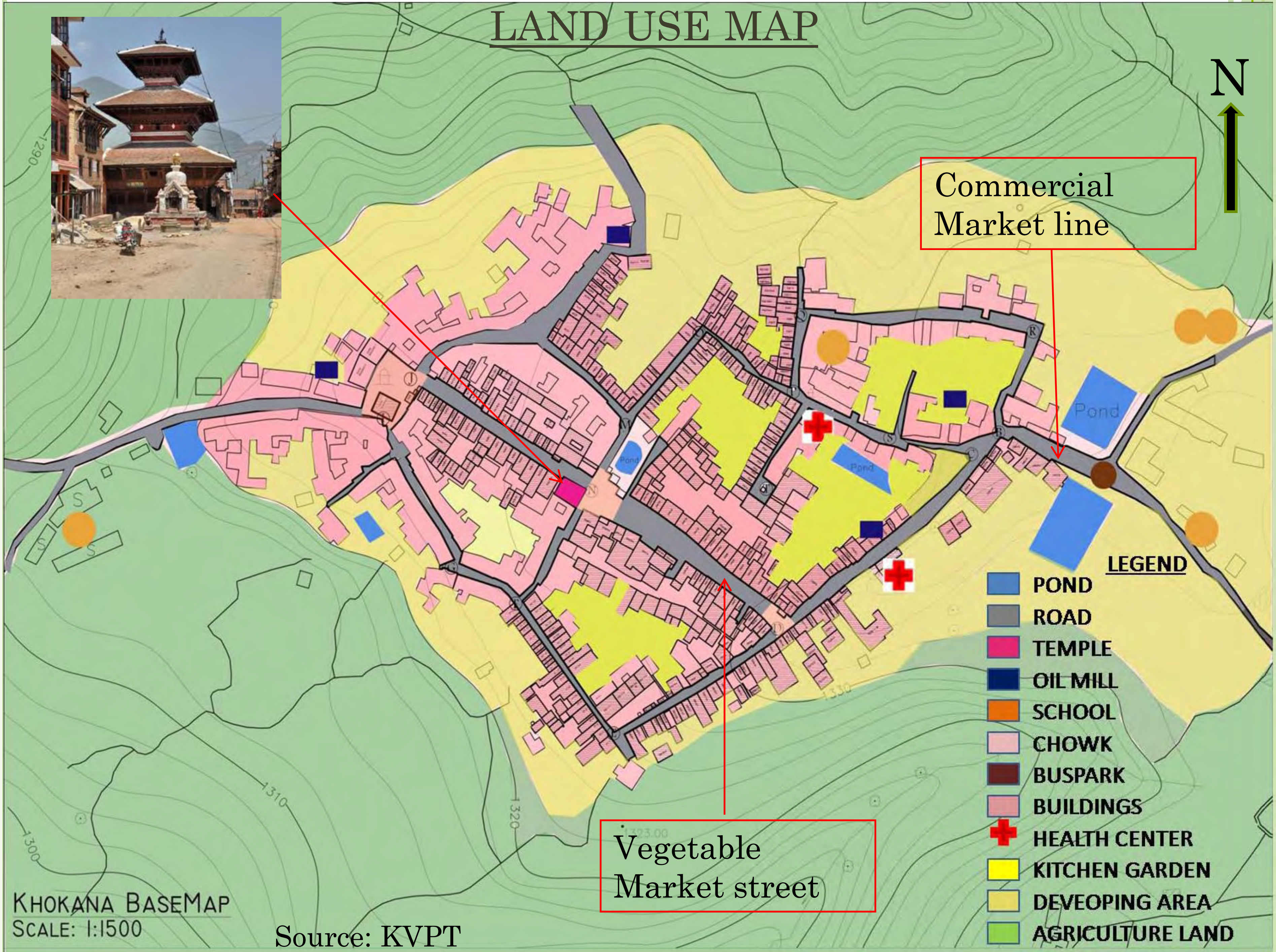
Elements of SUSTAINABILITY

AN ANALYSIS OF EXISTING SCENARIO

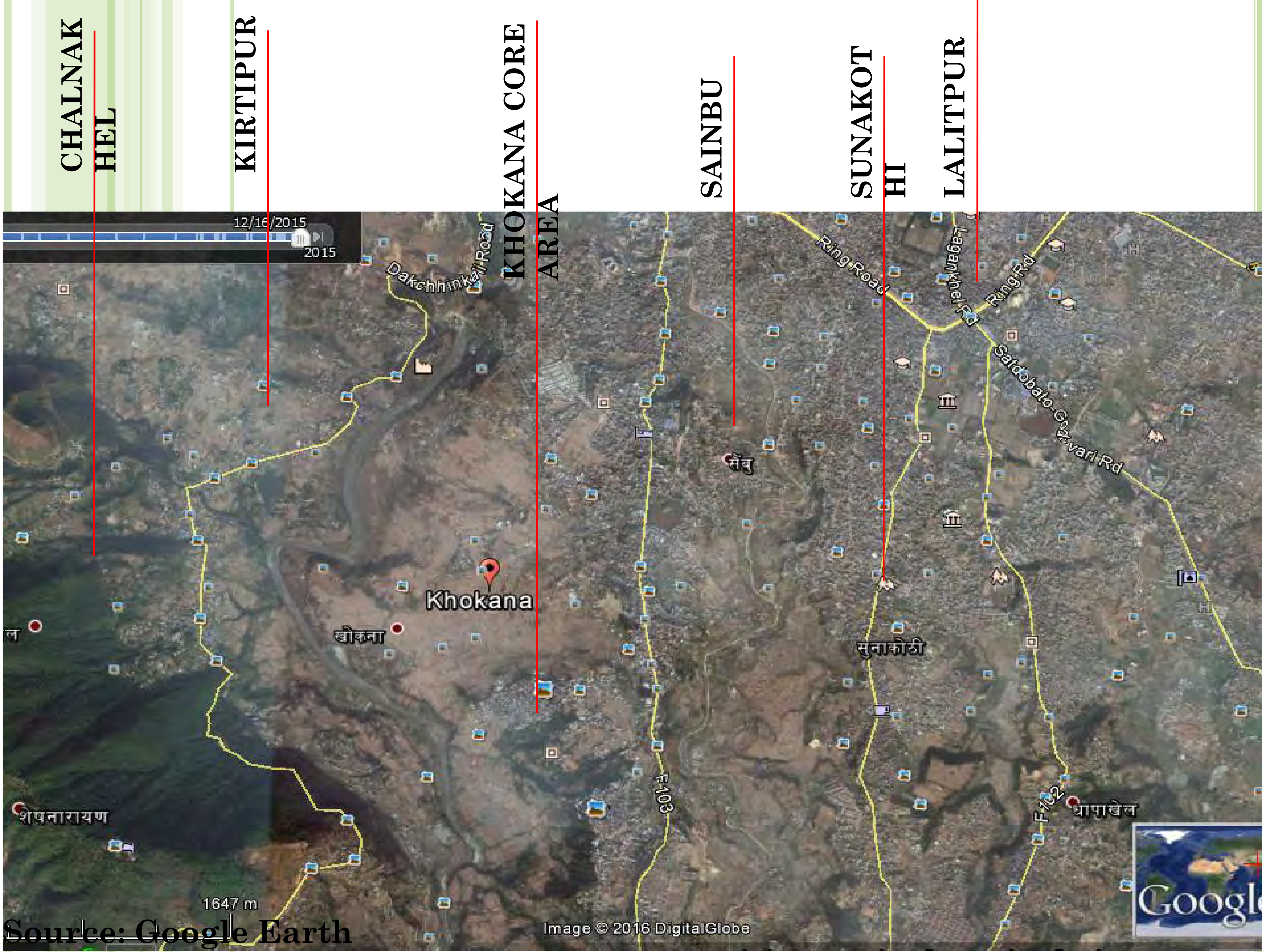
LAND USES

- Mixed Land Use → Diversity
- Comprises of
    - built form- residences, temples, school, health centre, oil mill
    - Open spaces- agri-land, chowks, courtyard, kitchen garden, streets, community forest
    - Water bodies- pond, hiti, wells
- Most part of land use occupied by agriculture → not much affected by urbanization
- A community forest- sparse → but still affecting the micro climate

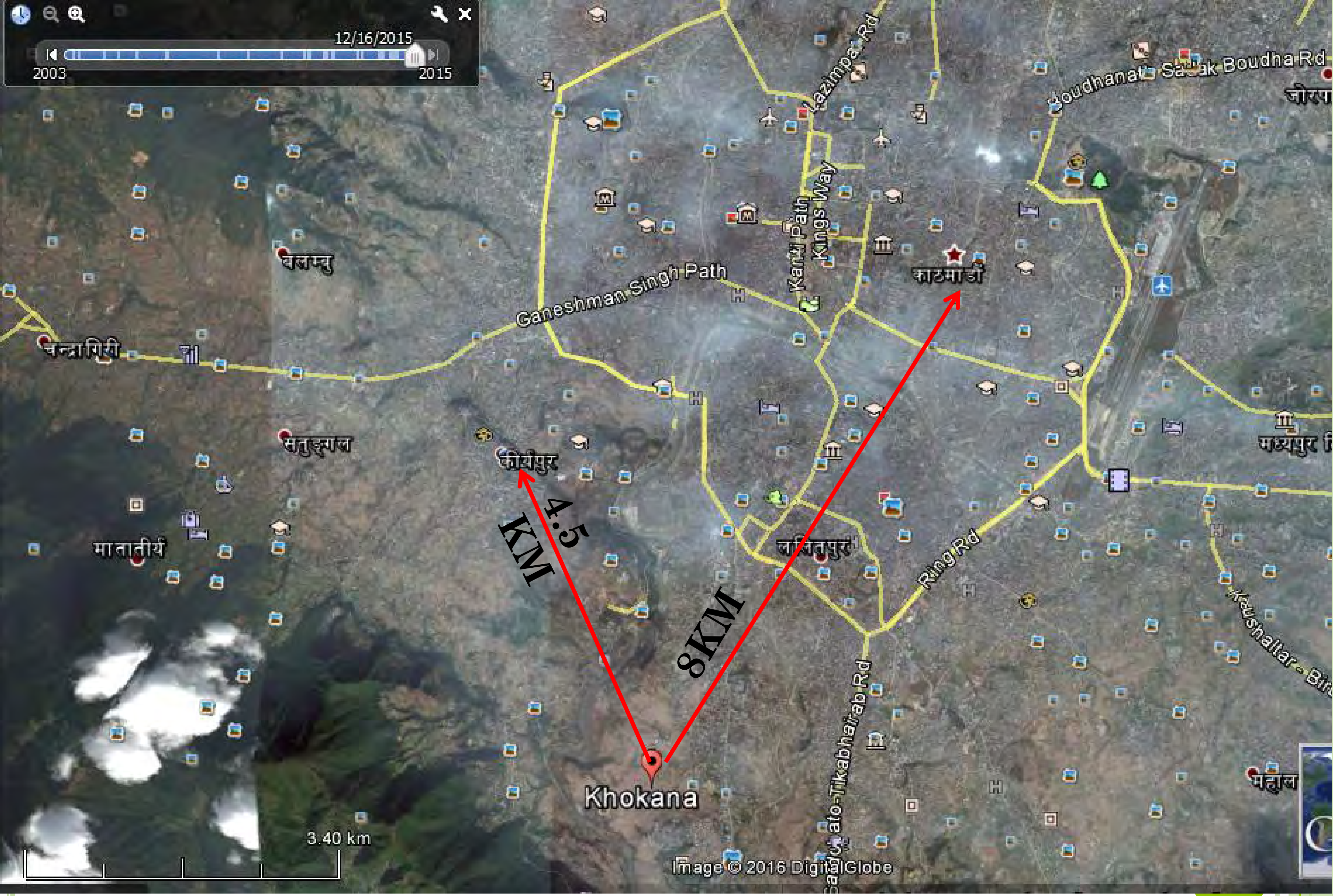
LAND USE MAP



Source: KVPT



Source: Google Earth



Source: Google Earth

LAND USE PATTERN OF THE YEAR 2003
Source: Google Earth

LAND USE PATTERN OF THE YEAR 2007
Source: Google Earth

LAND USE PATTERN OF THE YEAR 2011
Source: Google Earth

LAND USE PATTERN OF THE YEAR 2015
Source: Google Earth

2003

2007

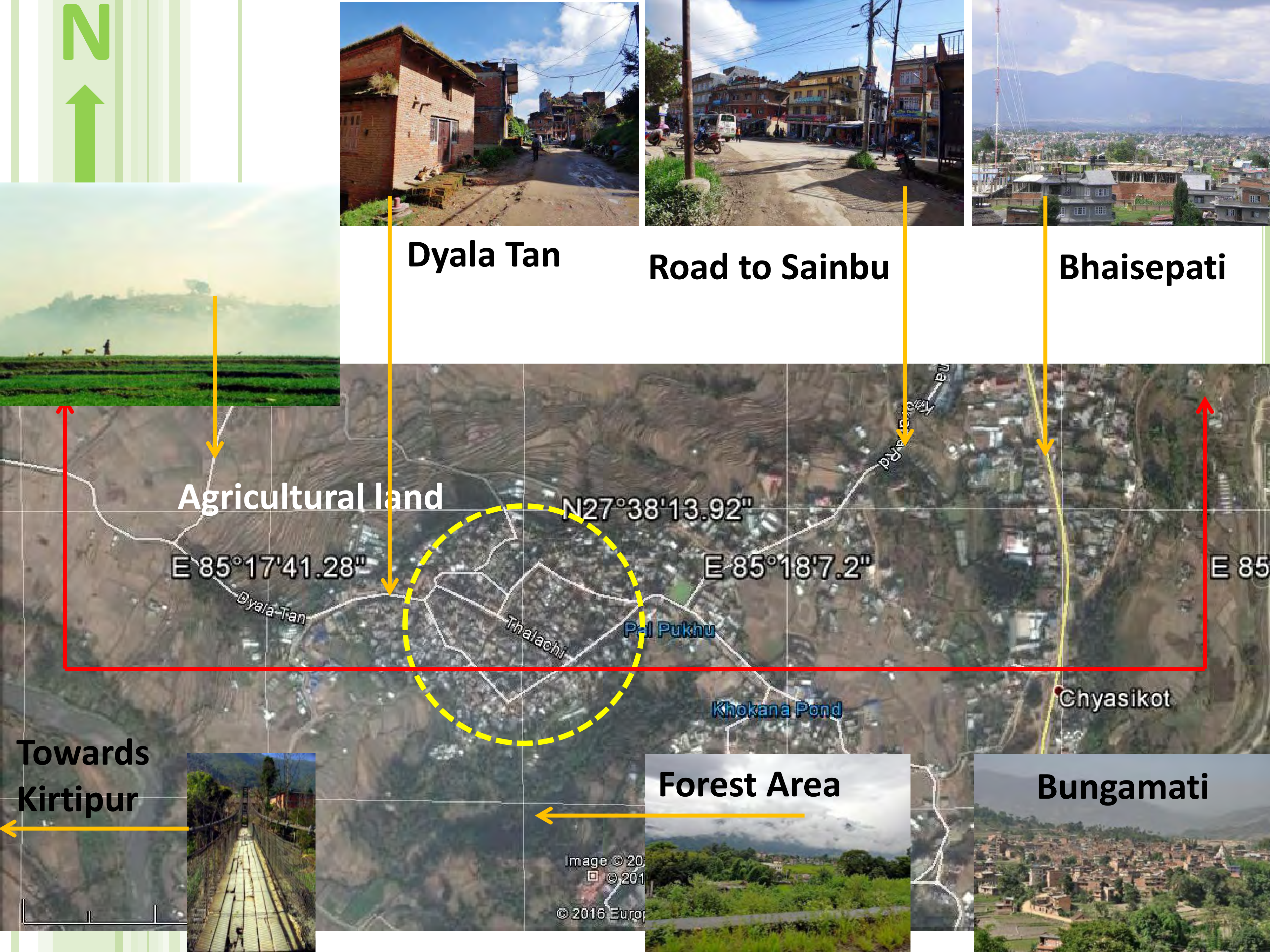
2011

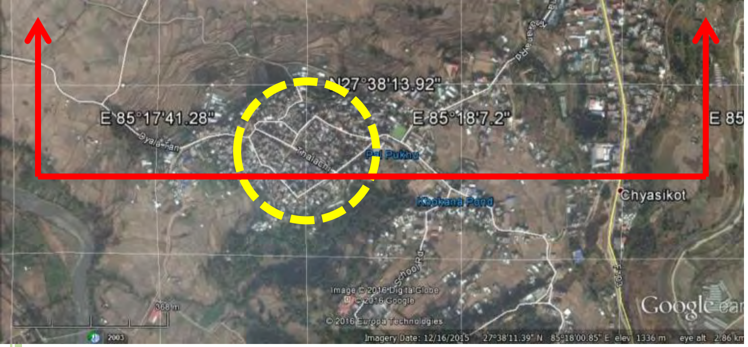
2015

Khokana in 2007
Source- Google earth

Khokana in 2015
Source- Google earth

Urbanization-South east part & North west


N
Dyala Tan
Road to Sainbu
Bhaisepati
Agricultural land
N27°38'13.92"
E 85°17'41.28"
E 85°18'7.2"
Dyala-Tan
Thalachi
Khokana Pond
Chyasikot
Towards Kirtipur
Forest Area
Bungamati



TOWARDS KIRTIPUR

TOWARDS BHAISEPATI

Traditional core settlement of khokana

Bungamati area through chyasikot

BAGMATI RIVER

KHOKANA

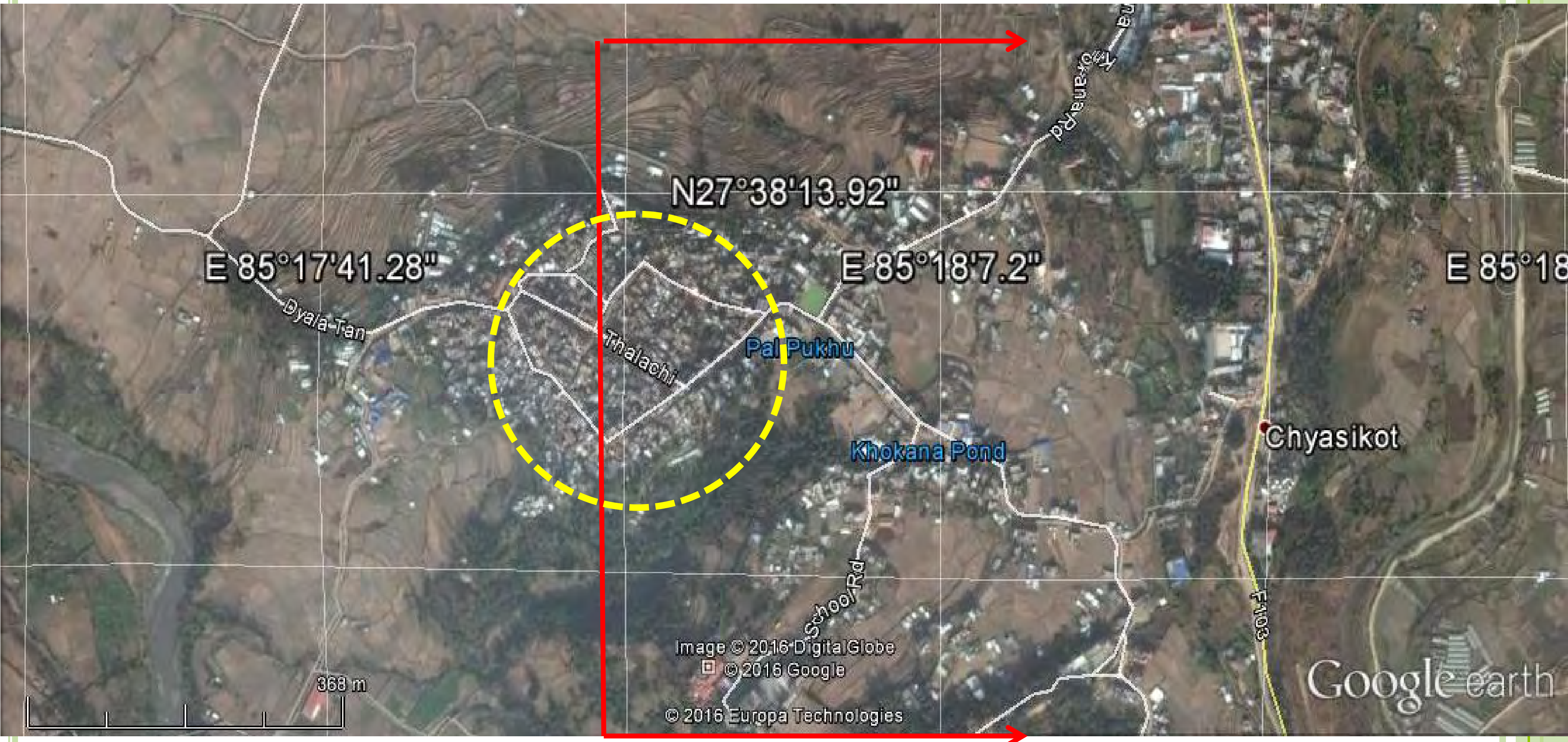
CHYASIKOT

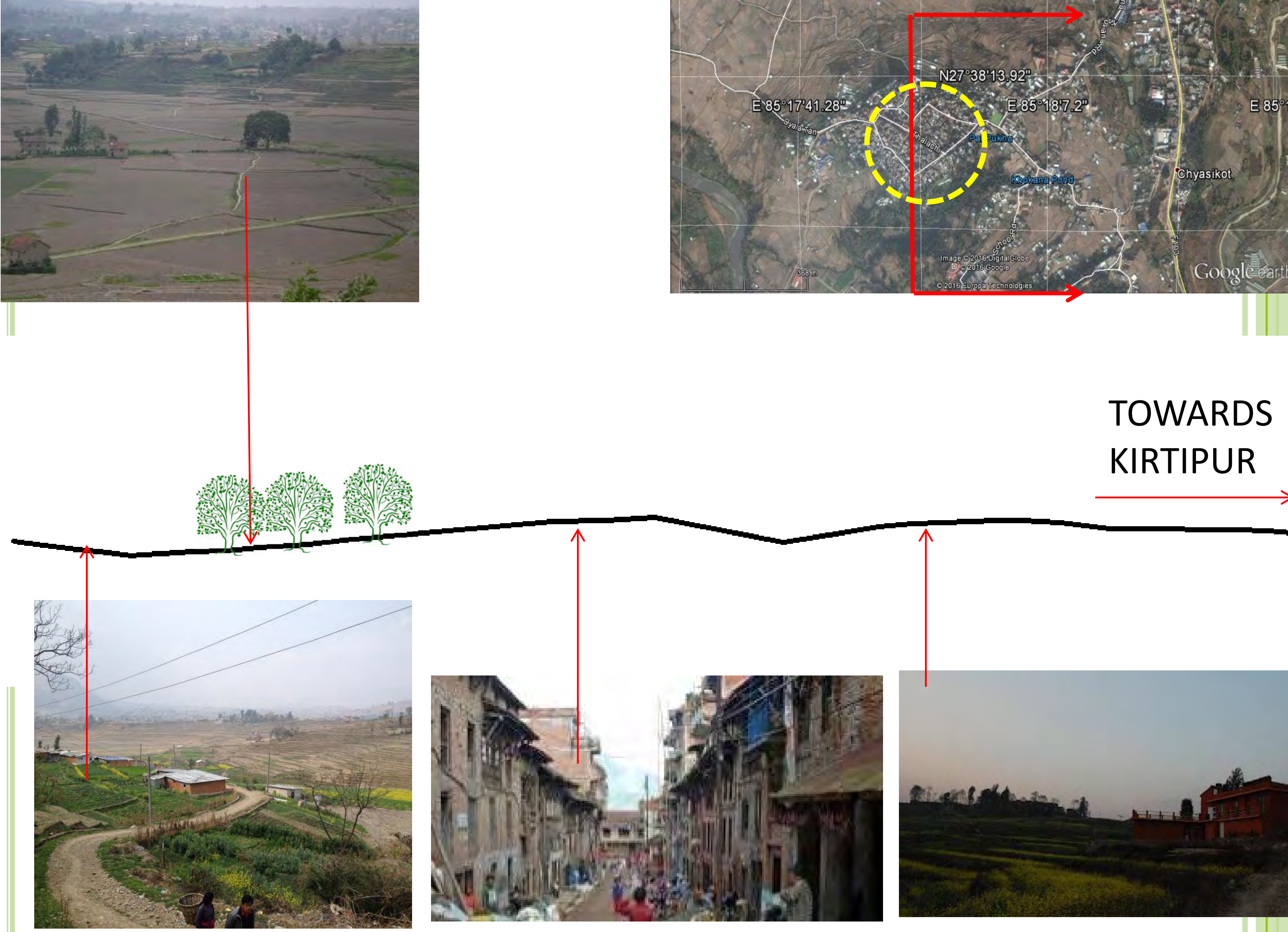
Bridge over Bagmati river

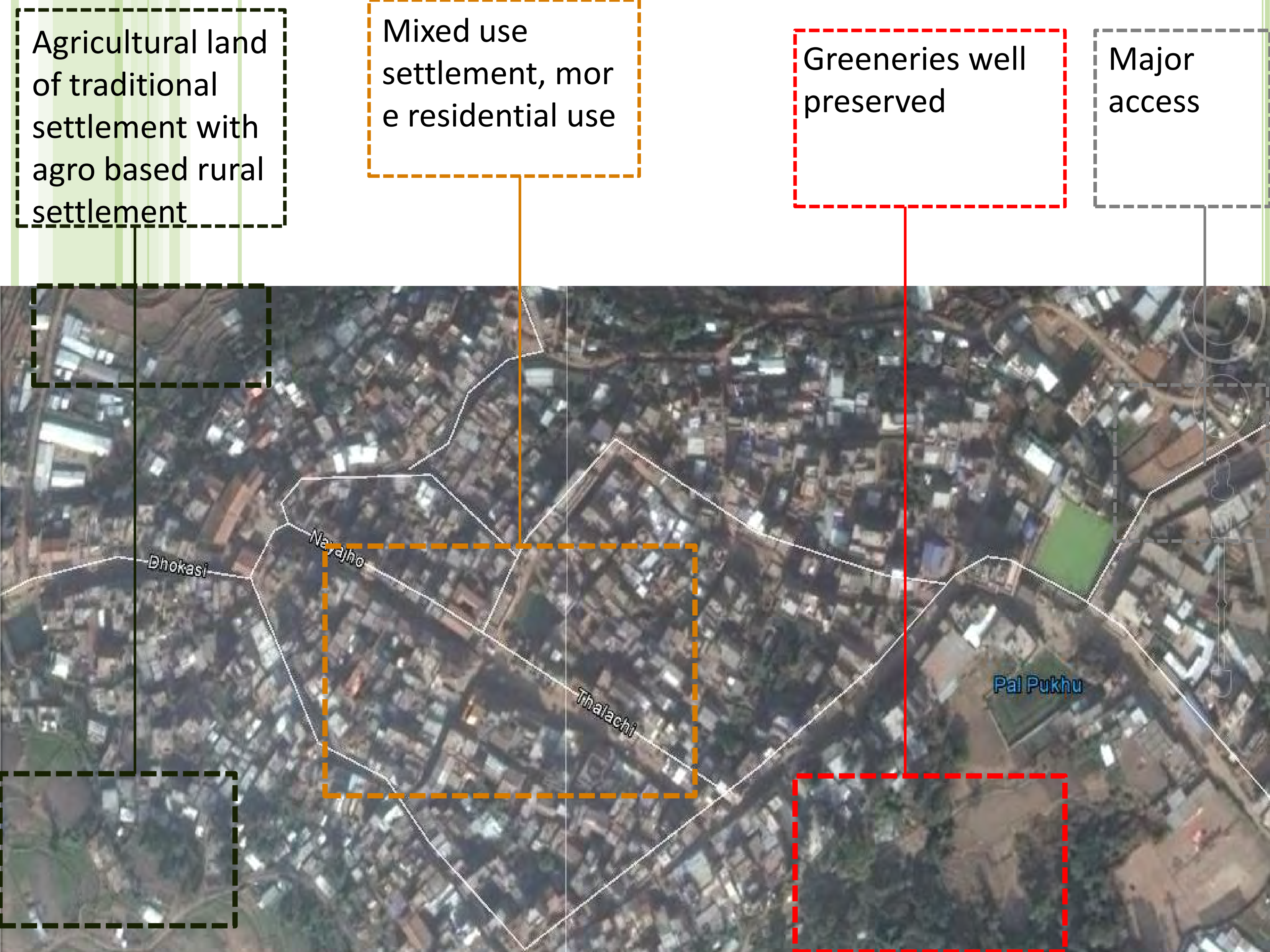
Karyabinayak Temple

Bungamati

Source: Google Earth

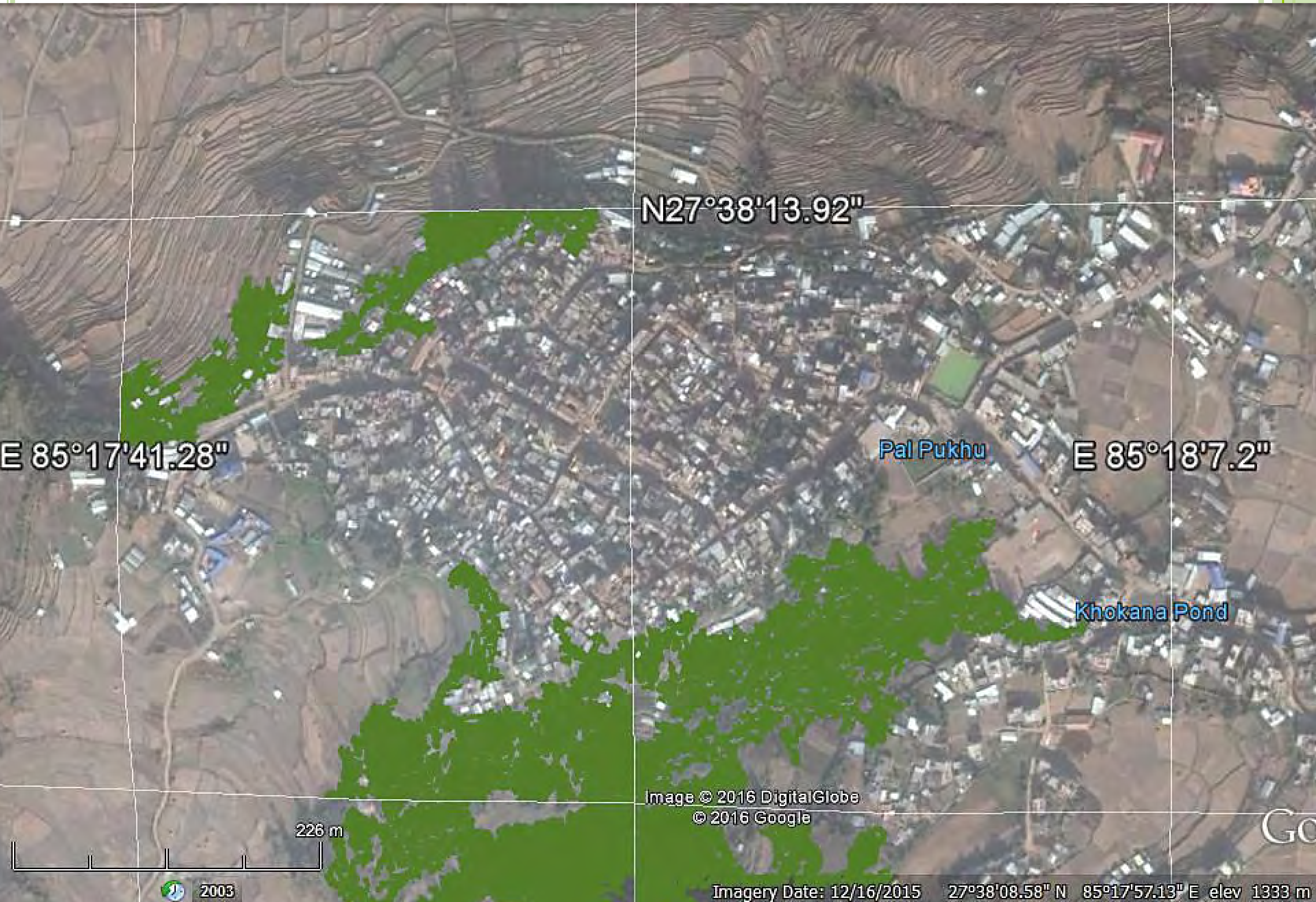



N27°38'13.92"
E 85°17'41.28"
E 85°18'7.2"
Chyasikot
Khokana Pond
Image © 2016 DigitalGlobe
© 2016 Google
© 2016 Europa Technologies
Google earth
TOWARDS KIRTIPUR
AGRICULTURAL LAND
KHOKANA CORE AREA
KHOKANA OUTSKIRT



Agricultural land of traditional settlement with agro based rural settlement
Mixed use settlement, mor e residential use
Greeneries well preserved
Major access
Dhokasi
Nayajho
Thalachi
Pal Pukhu

THE GREEN PERIPHERY



Khokana Dyala Tan towards Dhokasi

Khokana Main street

Khokana sub street

From Sainbu

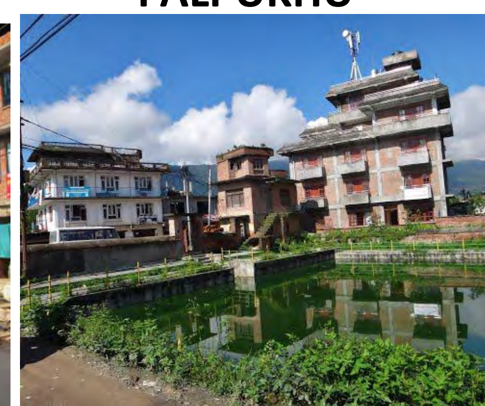
ROAD TO SAINBU

DHOKASI

NAYAJHO

THALACHI

PALPUKHU

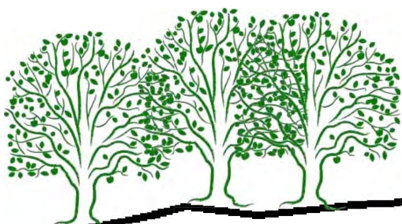


TRADITIONAL FEATURES

Towards Ghokasi

Karyabinayak

Dyo Pukhu



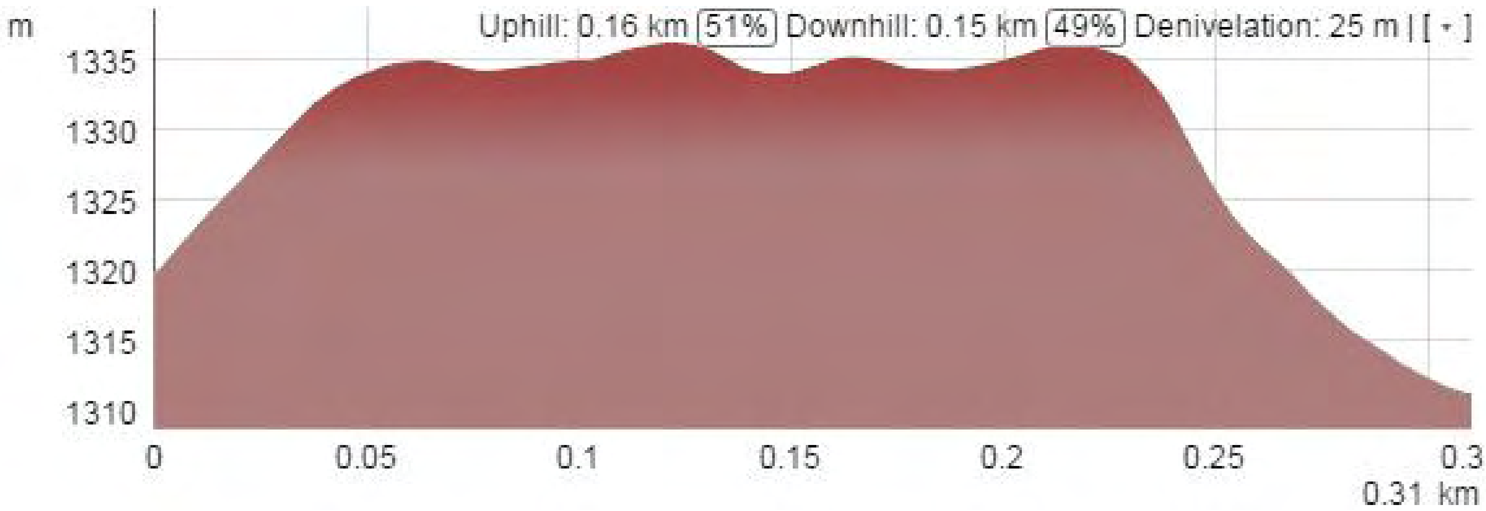
NAYAJHO

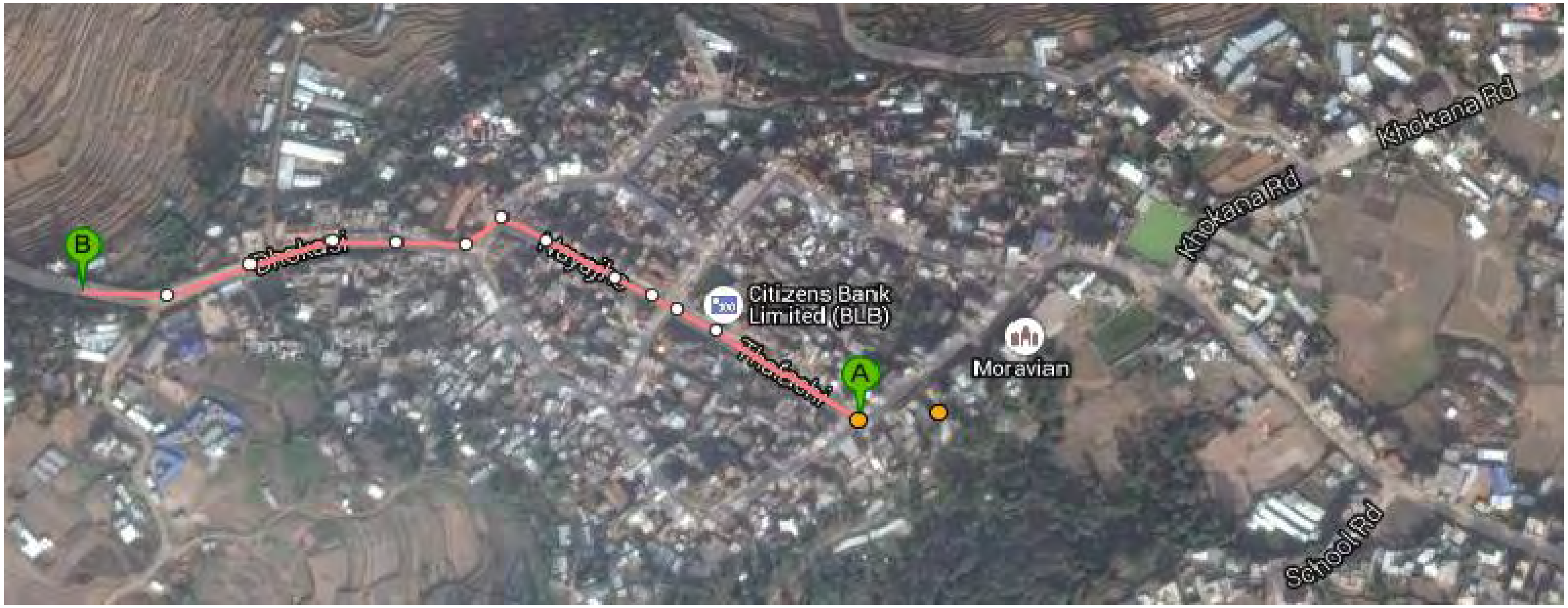
Greeneries
well
preserved

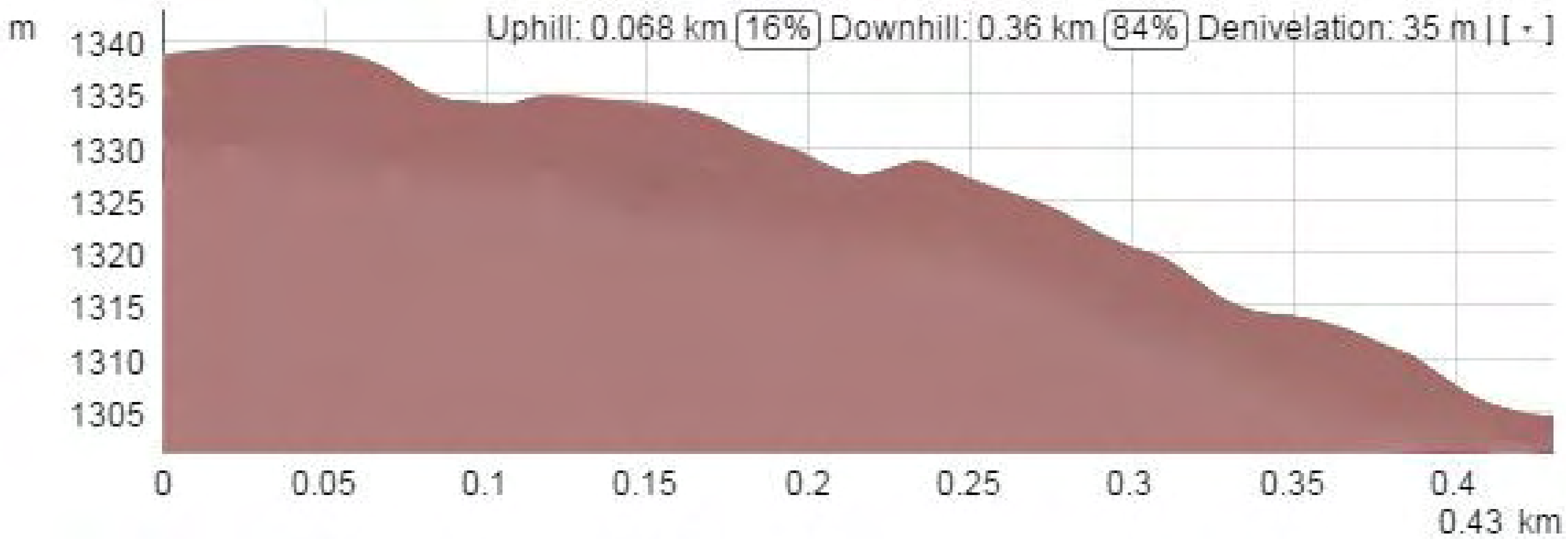
DENSE FOREST
AREA

AGRICULTURAL
LAND

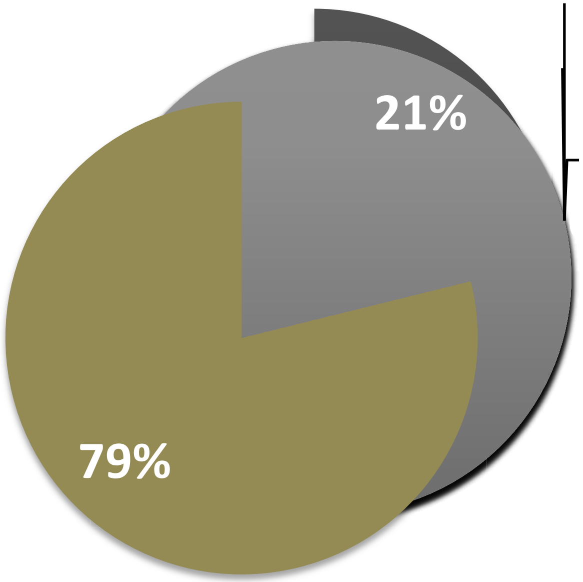
TOPOGRAPHY OF KHOKANA



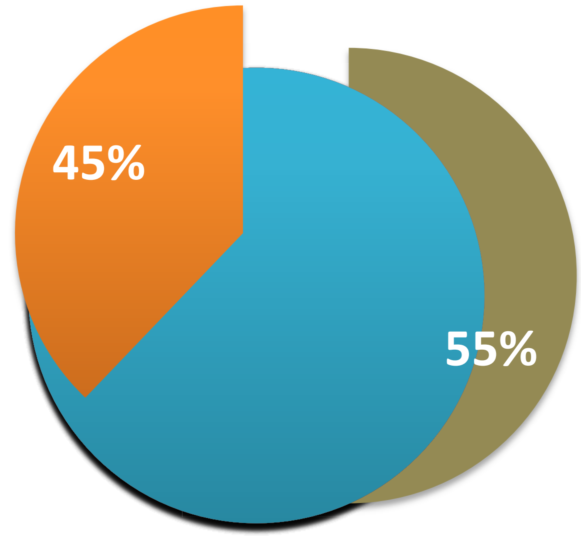

B
Citizens Bank
Limited (BLB)
A
Moravian
Khokana Rd
Khokana Rd
School Rd


m
1340
1335
1330
1325
1320
1315
1310
1305
Uphill: 0.068 km 16% Downhill: 0.36 km 84% Denivelation: 35 m | [·]
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.43 km

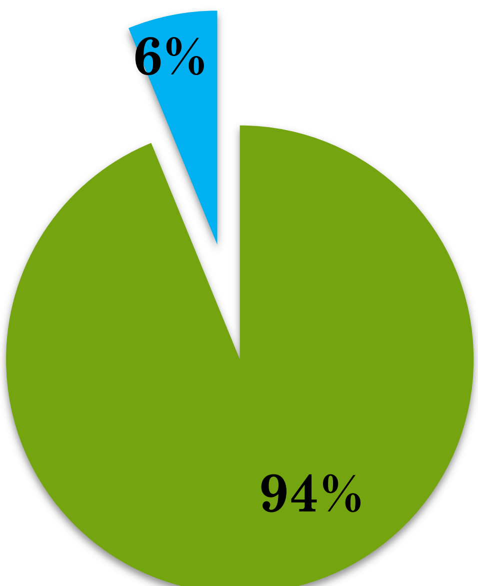
Source: Khokana Basemap



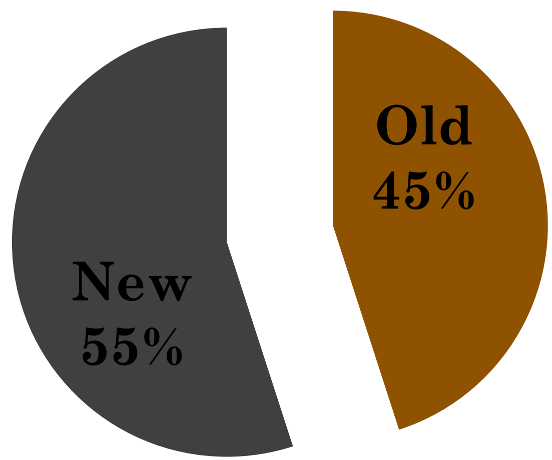
Area Occupied by road



Area Occupied by built up area



Area Occupied by water body



Ratio of old and new houses
(About 80% traditional houses destroyed after recent EQ)

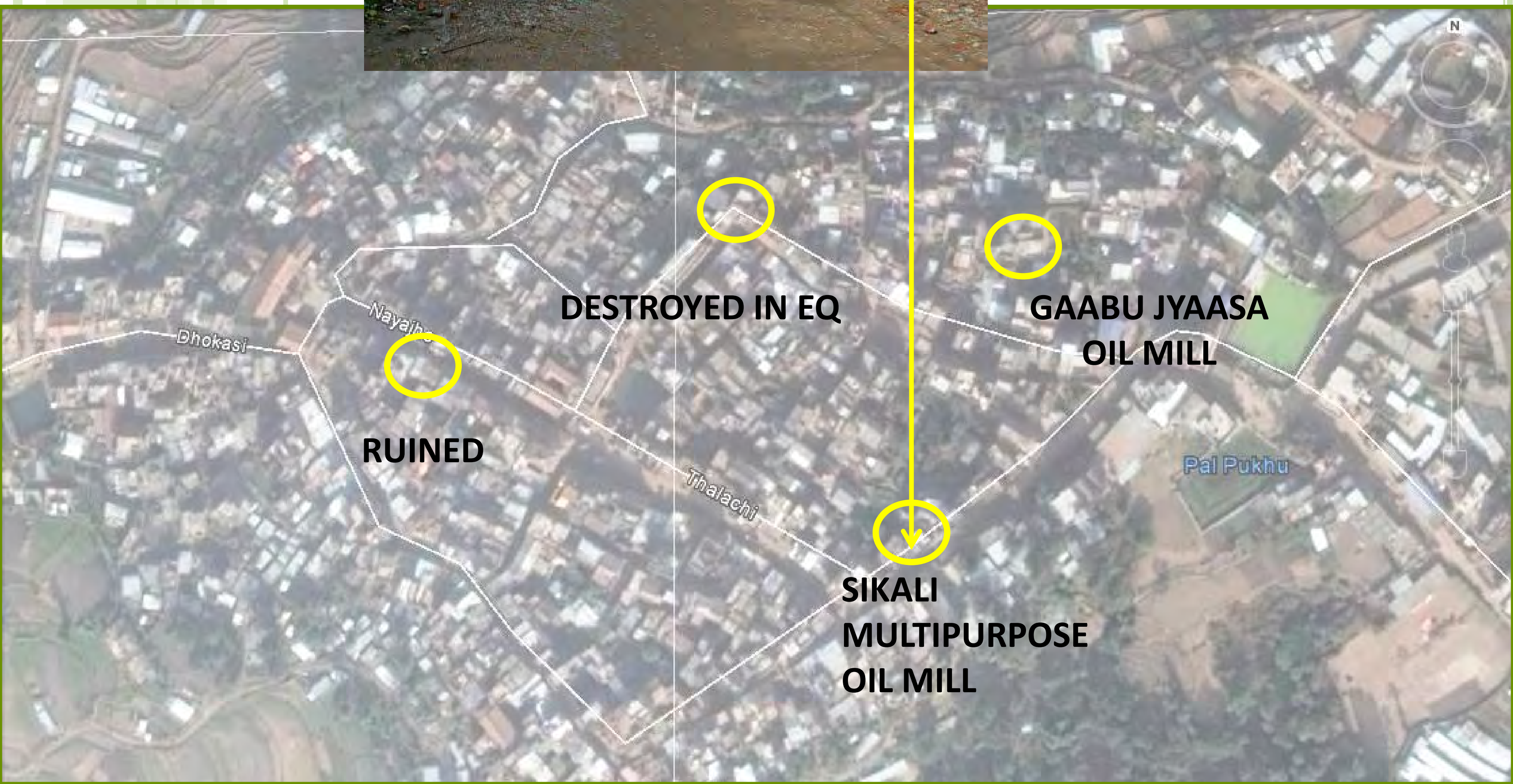
PONDS


N
DHOKASI PUKHU
Dhokasi
Nayajho
DYO PUKHU
GA PUKHU
KHA PUKHU
PAL PUKHU
KUTU PUKHU

PUBLIC WELL

SPACE FOR CULTURAL EVENTS (GUTHI)

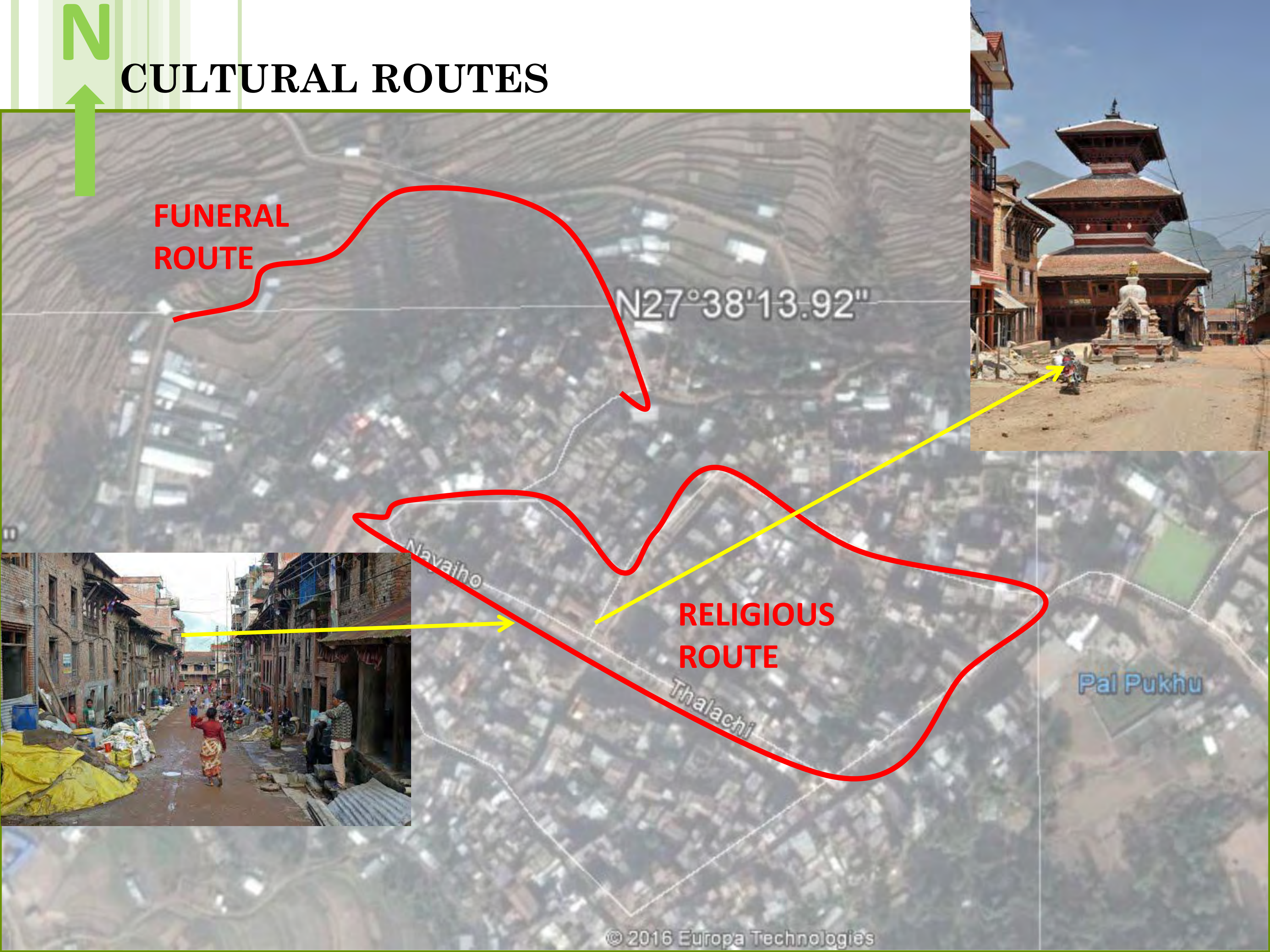
OIL MILL


DESTROYED IN EQ
GAABU JYAASA
OIL MILL
RUINED
SIKALI
MULTIPURPOSE
OIL MILL
Dhokasi
Thalachi
Pal Pukhu

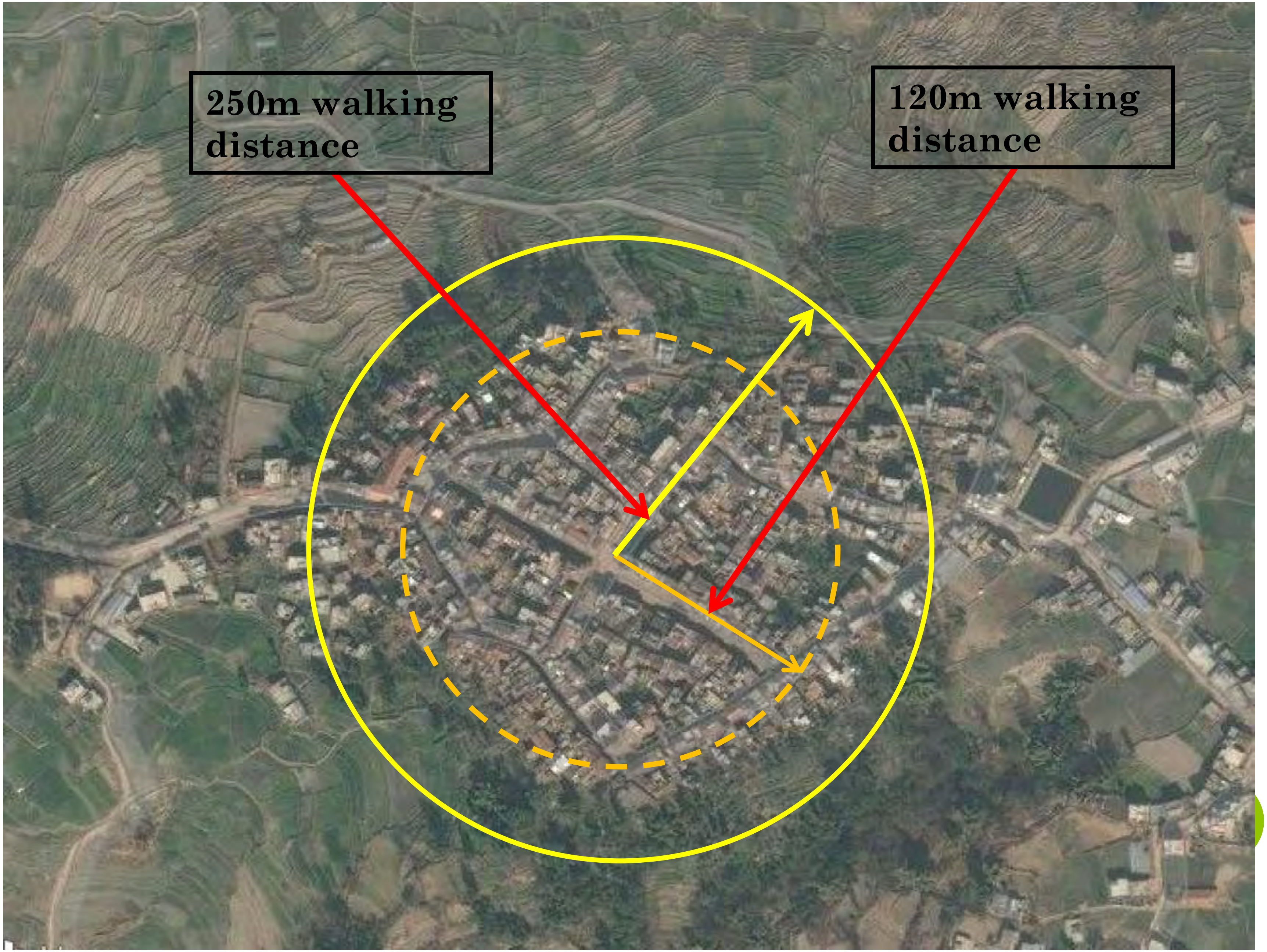
N


CITIZENS
BANK
BANK
Dhokasi
Nayajho
Shree Rudrayanee Mandir
Thalachi
Moravian
Khokana Rd
Google
Imagery ©2016 DigitalGlobe, Map data ©2016 Google
Terms
Privacy
maps.google.com.np
Send feedback
Edit the map
50 m

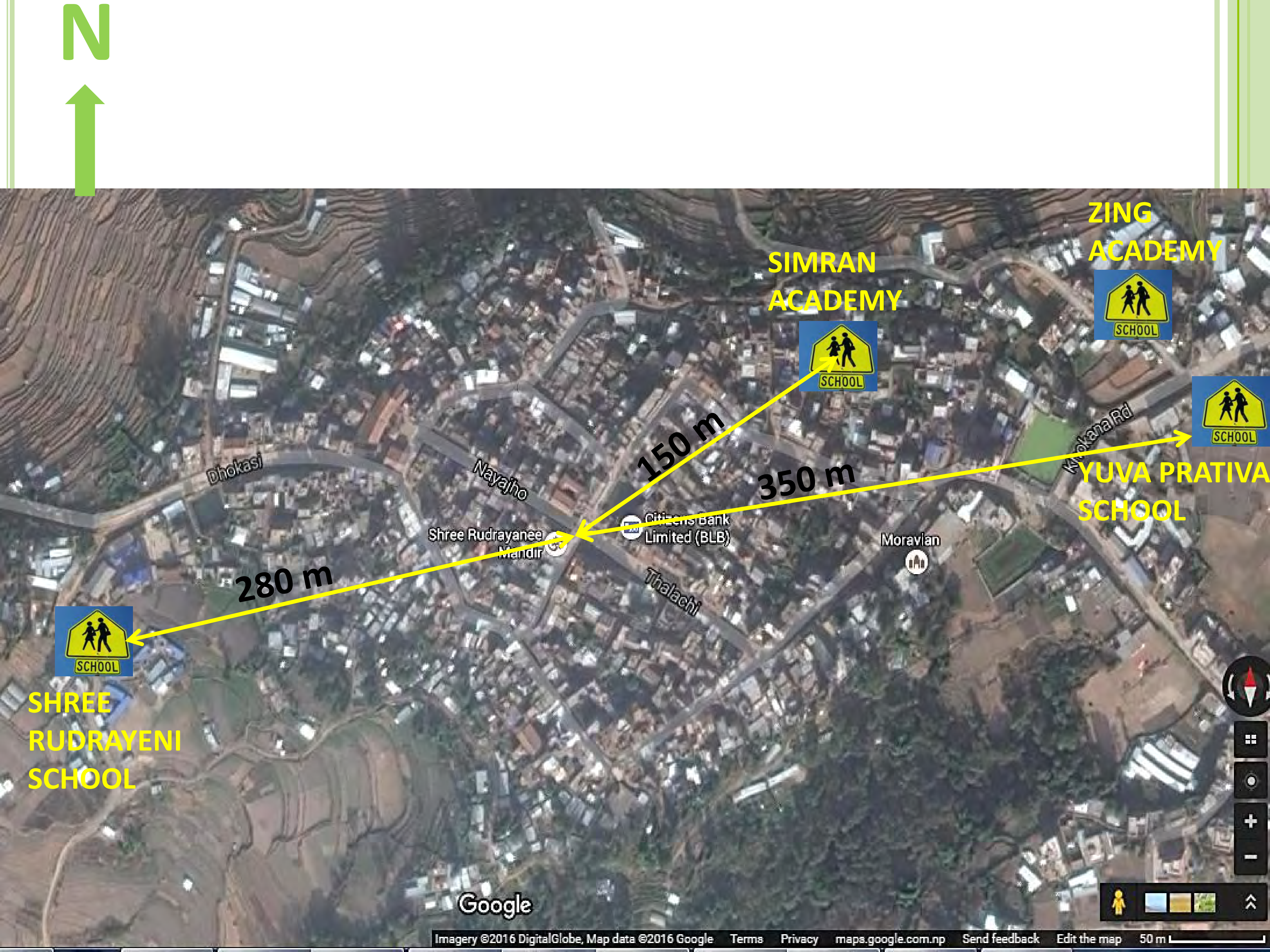
CULTURAL ROUTES



Is it a walkable city???



DISTANCE FROM CENTRE OF KHOKANA CORE AREA


N
SIMRAN ACADEMY
ZING ACADEMY
YUVA PRATIVA SCHOOL
SHREE RUDRAYENI SCHOOL
SCHOOL
SCHOOL
SCHOOL
SCHOOL
150 m
350 m
280 m
Dhokasi
Nayajho
Shree Rudrayanee Mandir
Citizens Bank Limited (BLB)
Thalachi
Moravian
Google
Imagery ©2016 DigitalGlobe, Map data ©2016 Google
Terms
Privacy
maps.google.com.np
Send feedback
Edit the map
50 m

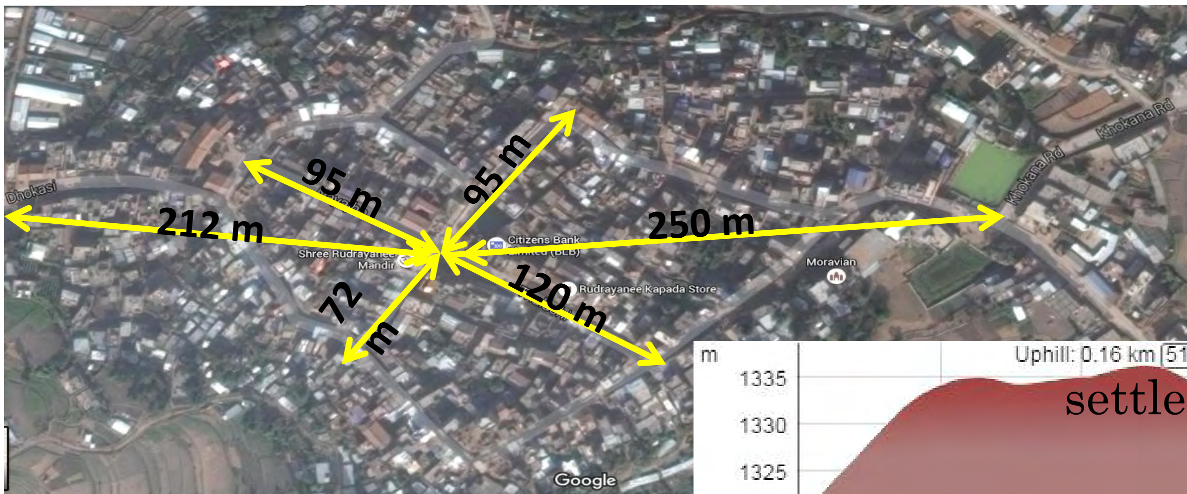

RUDRAYENI
PHARMACY
Dhokasi
Nayajho
Citizens Bank
Limited (BLB)
Shree Rudrayanee
Mandir
Moravian
Khokana Rd
120 m
Jhalachi
UPA SWASTHA
CHOWKI
50 m

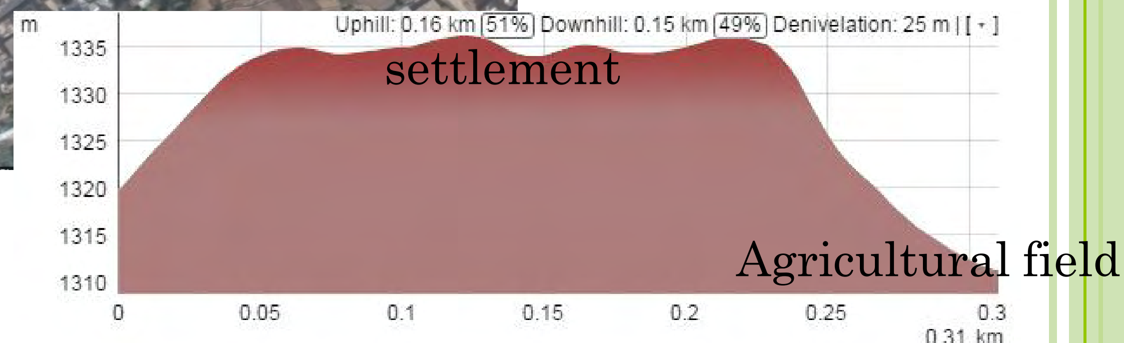
Elements of SUSTAINABILITY

LAND USE

Land use

- The residential settlements located on elevated tar land and is a COMPACT one.





- The compact pattern of housing frees up land for public spaces.
- The domain of the built area is surrounded by the agriculture domain on the terrain and the valley

Built Form

- Residences

- Purely traditional houses
  - Row(with kitchen garden)
  - Cluster(with common courtyard)
  - Courtyard

- Decent, affordable, convenient
- Thermally Comfortable
- Materials- Locally available, water accepting low hazardous waste

sustainable

Source: Conservation studio, IOE, 2010

- RCC Contemporary Houses- deteriorating the streetscape
- Mixed type- reconstructed adding RCC floors or terrace
- Temporary shelters- on the core periphery

unsustainable

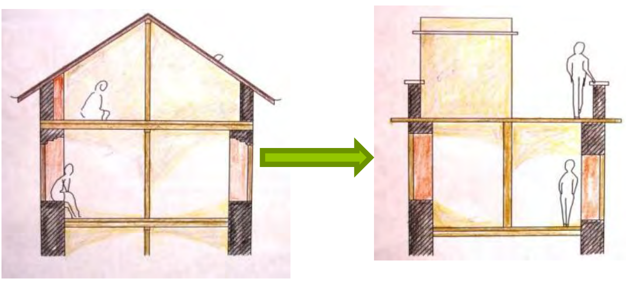
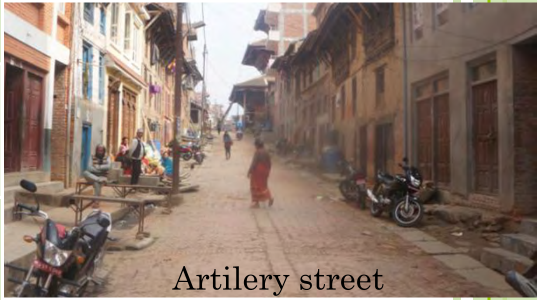


Fig: Change in construction trend

STREETS

Factors of Sustainability	Reason for sustainability
Social	Streets are design to **prioritize walking**
	Streets are interlinked to every basic service
	Connected to all the chowks and courtyards
	Can be **accessed anywhere on foot**
	Social activities flourish in the streets, jatras and festivals
	Extension space for daily household activities,
Environmental	No air pollution
	Natural irrigation(sloped towards the agricultural field)
	Open joint brick and stone paved are good for **water recharge**

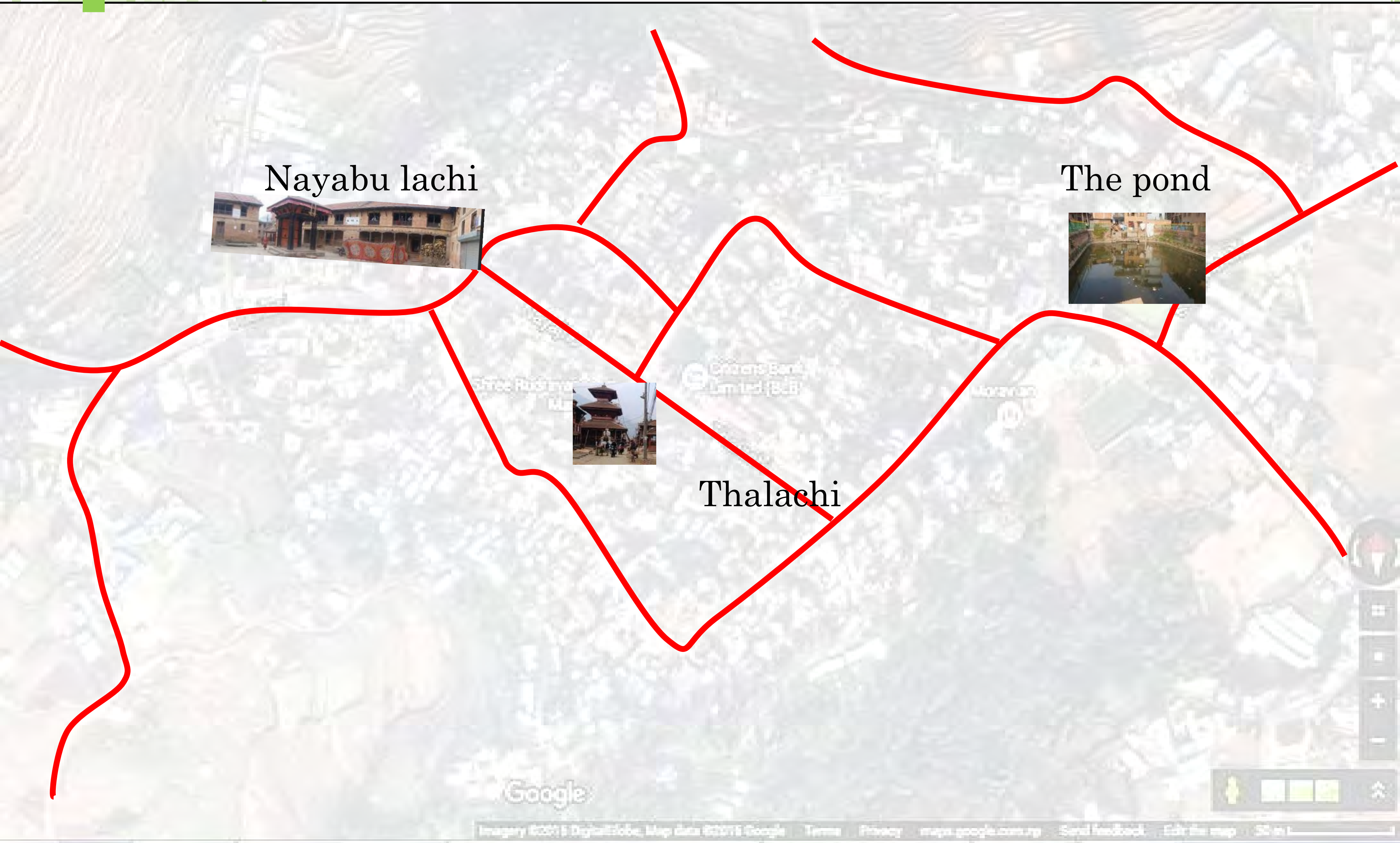

Major street


Artilery street


Open joint stone paved

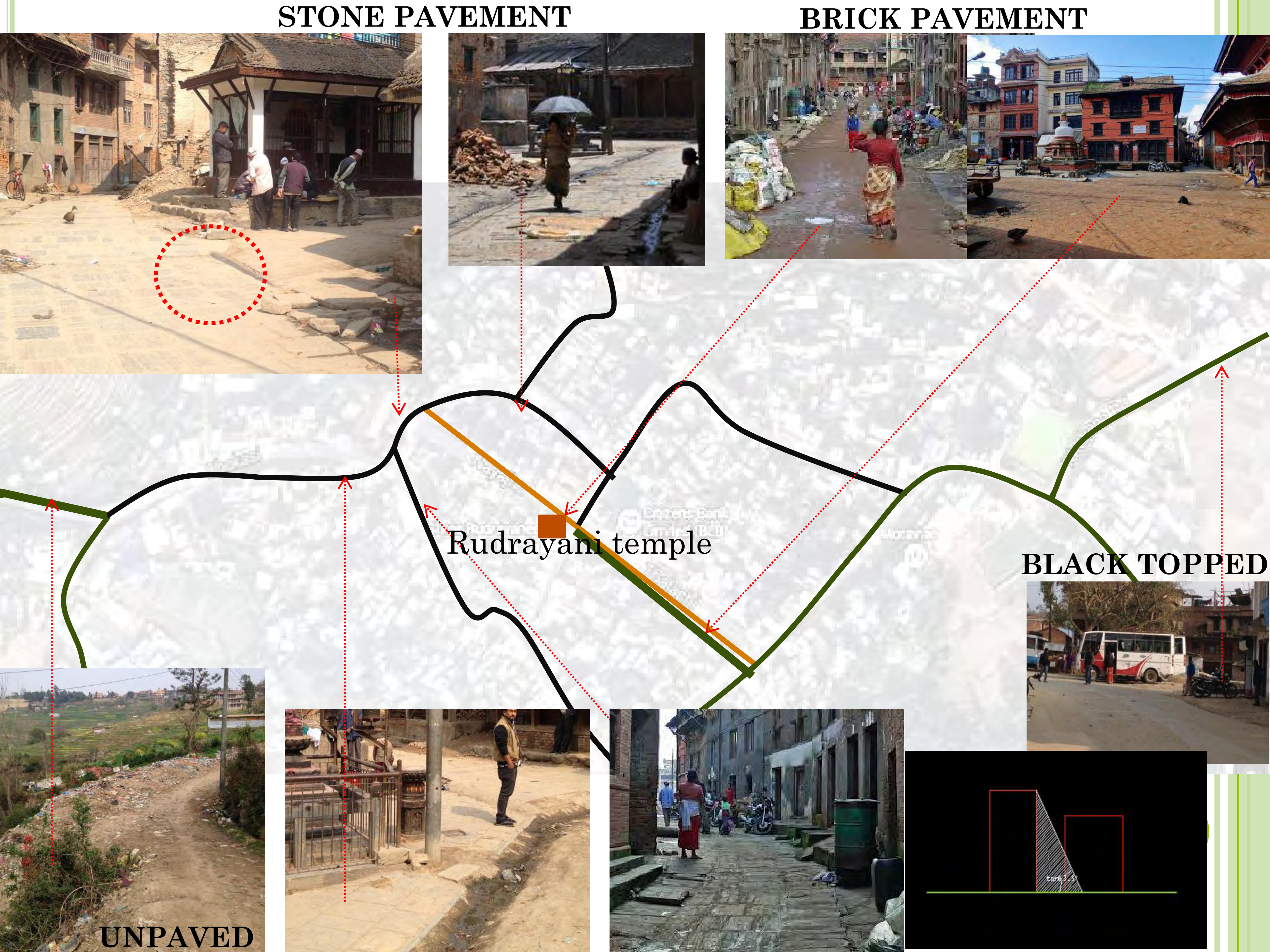

Open end brick paved

STREET PATTERN- culturally guided



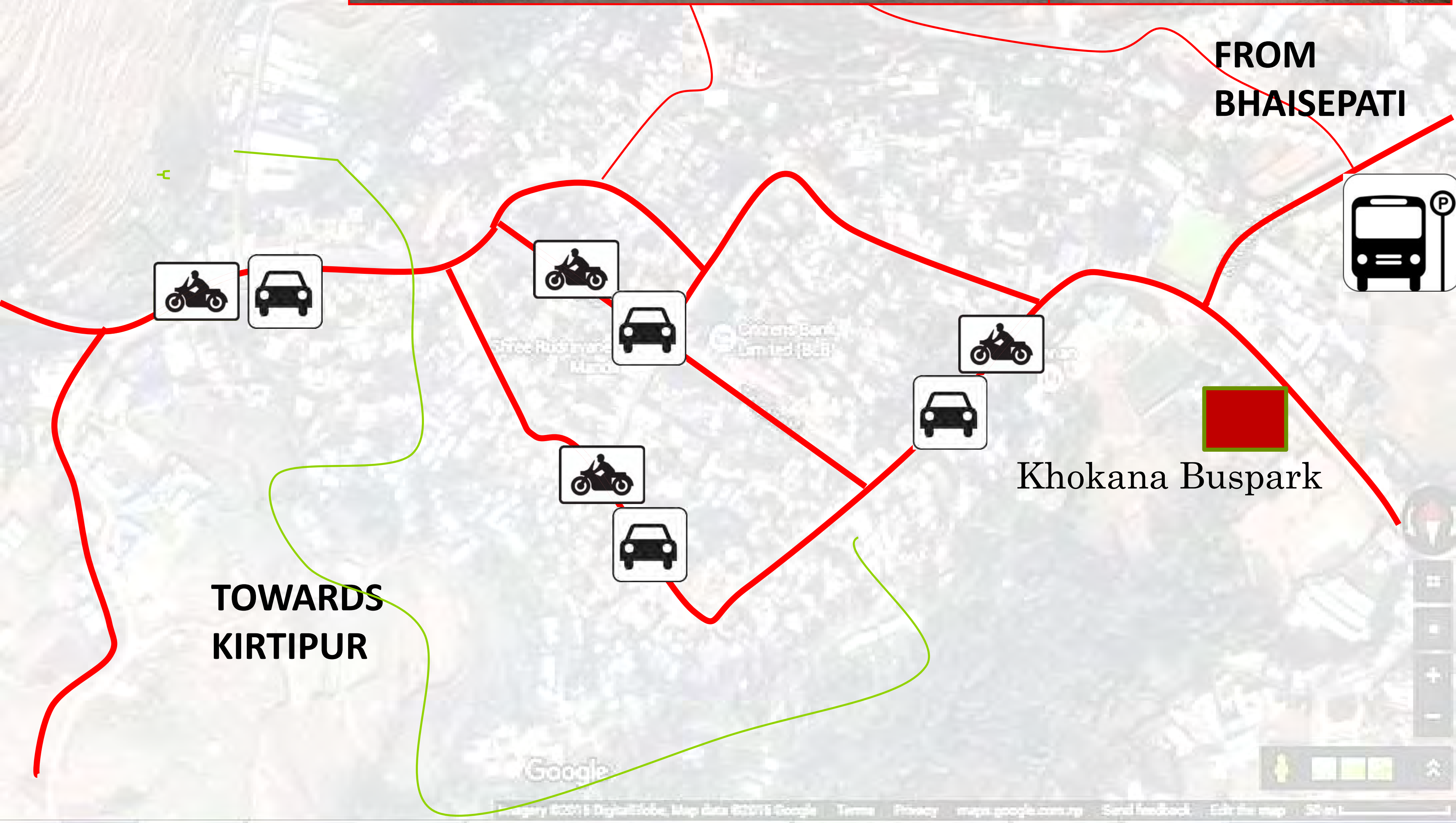
OPEN SPACES

Nhyabu Lacchi
Tyajya Tole
Gaabu Pampa
Dunechhen Lacchi
Chwe Lacchi



STONE PAVEMENT
BRICK PAVEMENT
Rudrayani temple
BLACK TOPPED
UNPAVED

VEHICULAR PATTERN



Open spaces

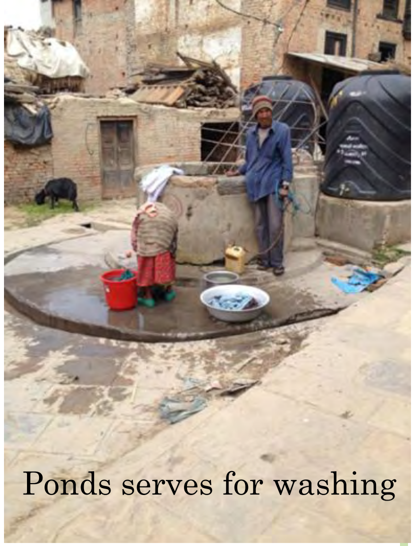
- Chowks generally crossroad of streets

Factors of Sustainability	Reason for sustainability
Social	**1.** Extension space for daily household activities
	2. Point of community interaction and leisure activities
	3. Social activities flourish – festival, jatra etc
Environmental	**4.** Mainting the micro climate
	5. Safe place in case of disaster
Economical	**6.** A node for market place

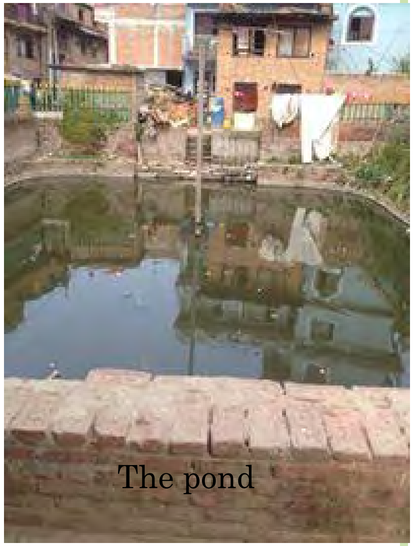
WATER BODIES

Factors of Sustainability	Reason of sustainability	
	Well &Hiti	**Pond**
Socio-cultural	Daily activities like bathing, washing takes place	Jatra/ festival performed every year
Environmental	Water storage for fire fighting	
	Maintaining natural water cycle	
	Ground water recharge	
Economical		Fishery- income generation

- Well &Hiti- most of them in a deteriorating condition- not functioning
- Pond- Most of them polluted or dry



Ponds serves for washing



The pond

The dry out Hiti

Existing sustainability scenario and Recommendations for land use

Indicators of Sustainability	Sustainable? Yes	No	Ok	Recommendations
Built form				
Compactness of built form	√			
Basic services at walk able distance	√			Outgrowing of buildings should be controlled by planning a proper satellite city.
Change in building form		√		Policy implemented to not disrupt the traditional streetscape, the skyline an Khokana's identity
Streets				
Accessibility of streets	√			
Paving material of streets			√	Encouraging the use of open joint for water recharge
Streets light		√		Can have PV streets light
Streets safety			√	Can have a proper footpath
Handicapped friendly		√		

EXISTING SUSTAINABILITY SCENARIO AND RECOMMENDATIONS FOR LAND USE

Indicators of Sustainability	Sustainable?		Recommendations
	Yes	No	
Open spaces			 The dry pond
Courtyard	√		
Chowks	√		
Water bodies			
Well		√	Need to increase recharge for continuity in dry season
Hiti		√	Can be connected to harvesting water or pipeline for conservation
Pond		√	Fishery can be economically sustainable to conserve ponds

ECO-TOUR- FOR ECONOMIC SUSTAINABLITY

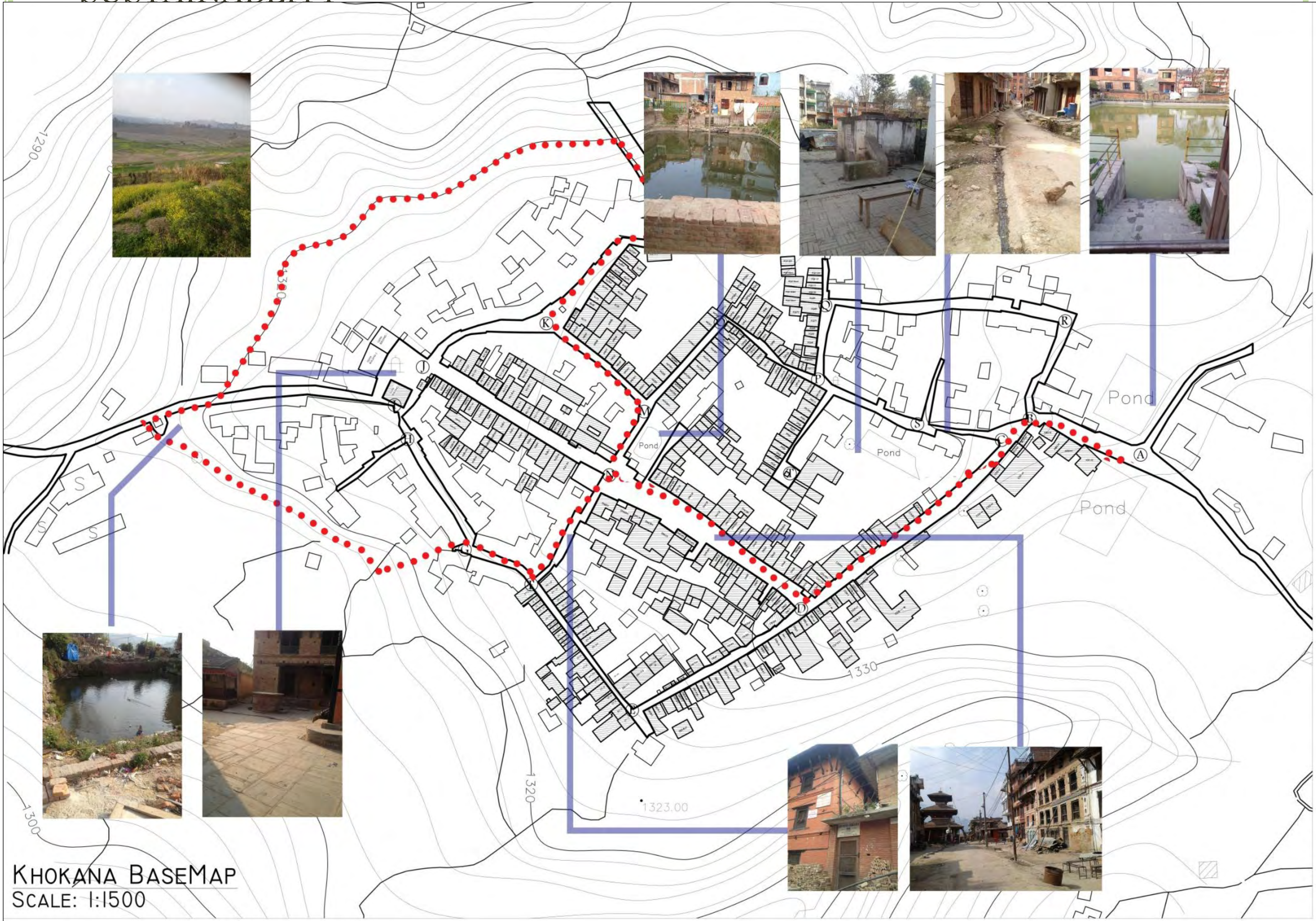
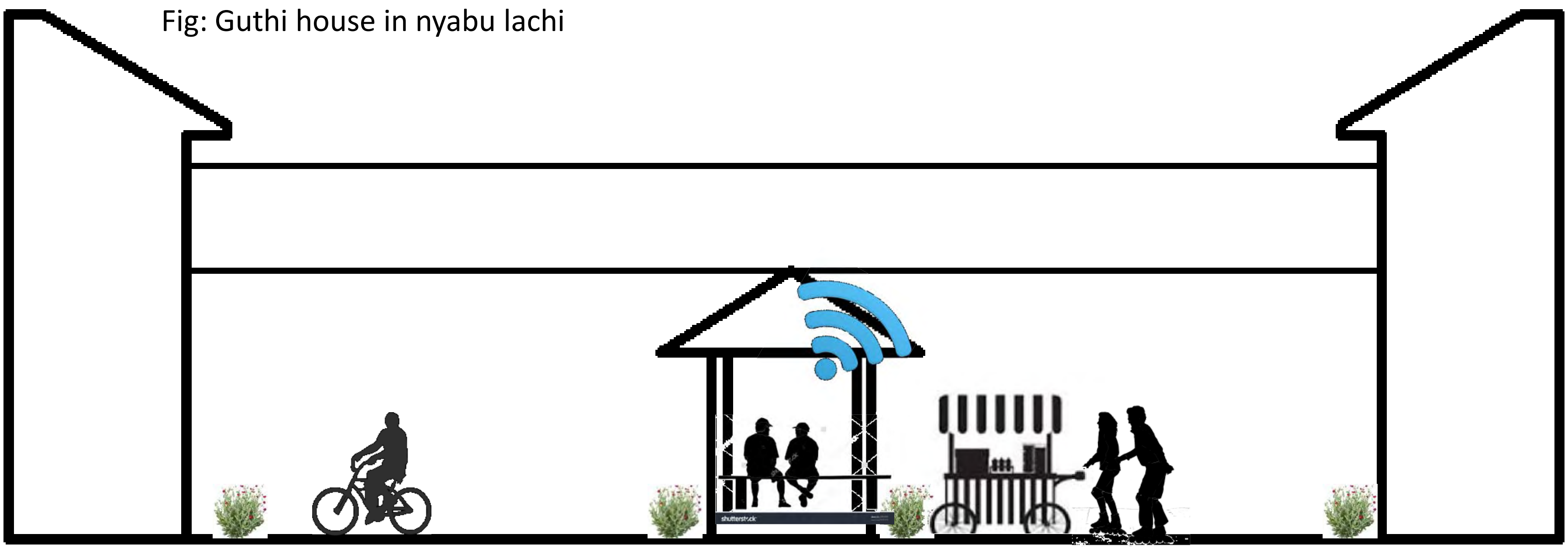
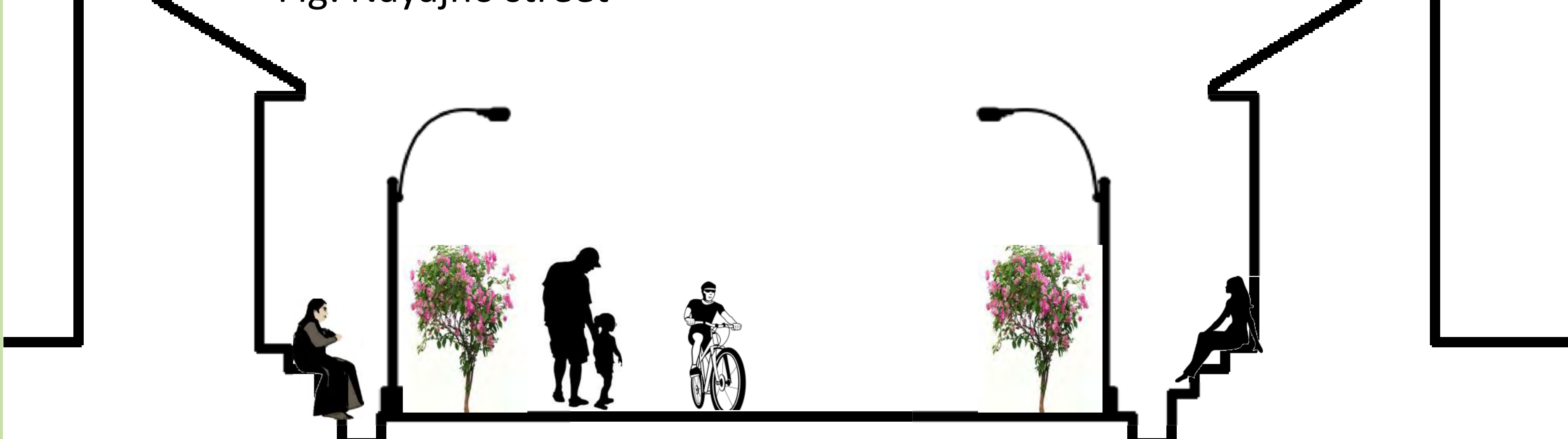


Fig: Guthi house in nyabu lachi



PROBABLE IMPROVED SCENARIO OF OPEN SPACES AT KHOKANA

Fig: Nayajho street



PROBABLE IMPROVED SCENARIO OF STREET AT KHOKANA

Water Supply And Waste Management

Sources

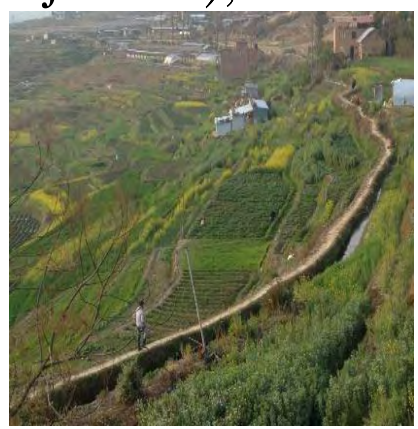
- **Traditional** : Well , Springs, Unlined Canal (*Raj Kulo*)




- **Modern** : Water Supply Scheme(Pharping-Bhaisenpati-Khokana), Lined Canal (Raj Kulo), Tanker


Pipe line


tap


rajkulo


tanker

Purpose

Drinking

Domestic Use

Irrigation

No Industrial use

Distribution

- Pipeline to 90% of the houses
- Community tap
- Canal Network to Agricultural land
- Drain

Present Condition of water supply

- Water deficiency (Available for 2 hr per week)
- Wells and springs are almost dry on winter
- Filtration or treatment is required before use
- Rain water drain out to agriculture field-good irrigation technique
- No practice of rainwater harvesting
- No practice of recycling grey water

Recharge

- All street and open spaces are bitumen, stone & brick paved
- Water is accumulated in ponds during rain due to slope topography
- Agricultural land contribute in recharge

Waste Water Management

Source

Kitchen /Toilet

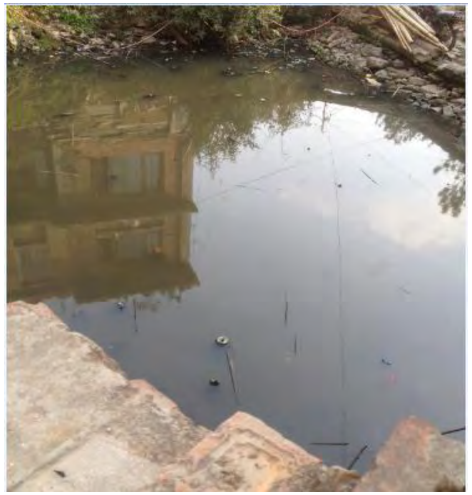
Cowshed

Rain



Management

Sewer, Pond, Accumulation in drain for Ducks, Gravity flow to lowland

Solid Waste Management

- Composting for manure (very few are practicing saga)



- Burning

Inorganic

Organic

organic waste burnt to ash

Burning of inorganic waste

Modern practice:

- Recycling

Plastic in container

Garbage collection area

- Transforming
- Solid waste like bones of (buffalo, chickens, ducks etc.) are transformed to pellet supplies as food for feeding chickens farms

Bones of animals

Collection of bones

Present Condition Of Waste Mgmt.

- Sewer line is available but all the waste conduit are not connected to it.
- Waste water is directly mixed in Bagmati river without any treatment.
- Grey water is accumulated in drain passing through house or they are flooded towards lowland, road or kitchen garden.

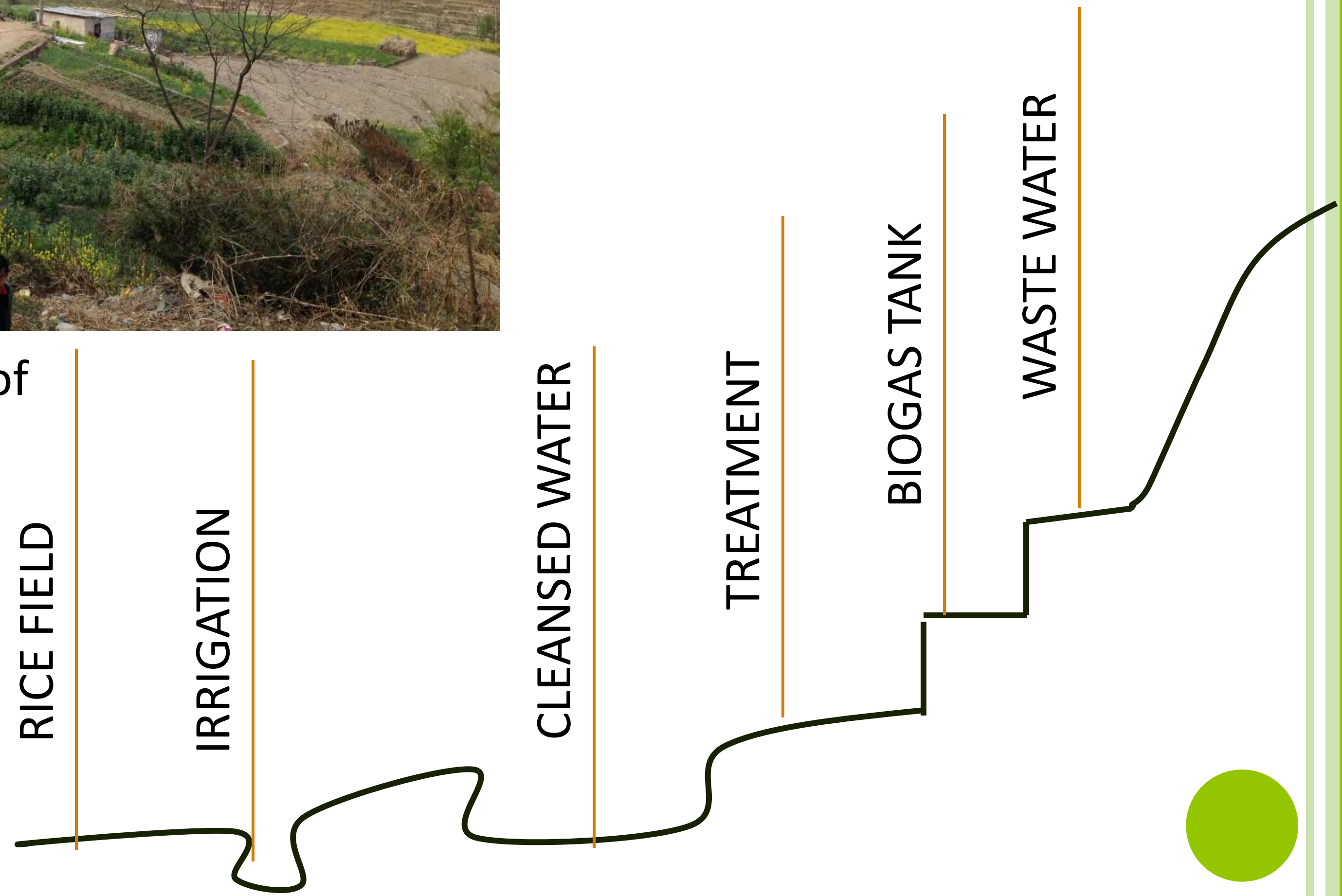
Surface open drain

Drain to lowland

Place for saga

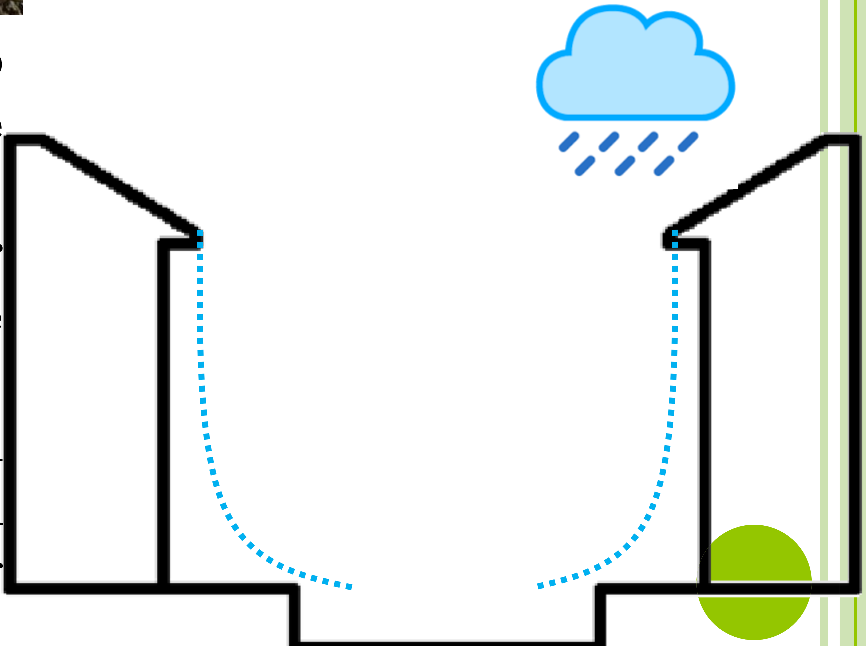
- After the recent announcement as municipality solid waste are collected by municipality as result "Saga" which is best practice of sustainability are under extinct.

Fig: Agricultural area of Khokana



PROPOSED PURIFICATION SYSTEM FOR WATER FOR IRRIGATION AT KHOKANA

Rainwater collection which can also serve for irrigation sources for the kitchen gardens within the tissue.



Assure a recharging of the groundwater table, which then can reinitiate the ancient stone spout system.

All buildings shall get an adapted system where rainwater is harvested separately (as a source for showering and toilets) and where grey water and black water get their respective circuits.

RECOMMENDATIONS FOR WATER SUPPLY

Parameters	Sustainable?			Recommendations
	Yes	No	Ok	
Source:				
Canals	√			
Water supply Scheme		√		Start up with rainwater harvest because Nepal have enough rainfall 1.5m/year
Lined Canal	√			
Imported (Tanker)		√		Search for another sustainable alternative
Distribution:				
Pipeline Network	√			
Community Tap	√			Adjust user behavior i.e dot not keep tap open
Irrigation Canal	√			
Recharge			√	Need to increase recharge by open joint brick paving

Recommendations for waste management

Parameters	Sustainable?			Recommendations
	Yes	No	Ok	
Waste water				
Sewer		√		Need treatment before mixing with other water bodies
Pond Accumulation		√		Should not mix sewer or grey water, Periodic sanitation is needed
Drain Accumulation		√		Done for ducks so, ducks should be reared in specific area
Solid waste				
Composting	√			
Burning			√	for ash, but CO2 emmision??
Recycle	√			
Transformation	√			
Municipal Collection		√		Promote practice of saga or biomass for solid waste.

Transportation

Road transportation

- networking of road.
- earthen, gravel, stone brick and metal road
- Most of roads are brick and stone paved which is open join type i.e.
- good aspect of water recharge and environment friendly.
- The road is about 2.5m to 3.75m wide which not only provide passage to the people but also act as the space to host the daily activities
- the road network is to the agricultural land is reach in the sense that all the roads are connected to the field.

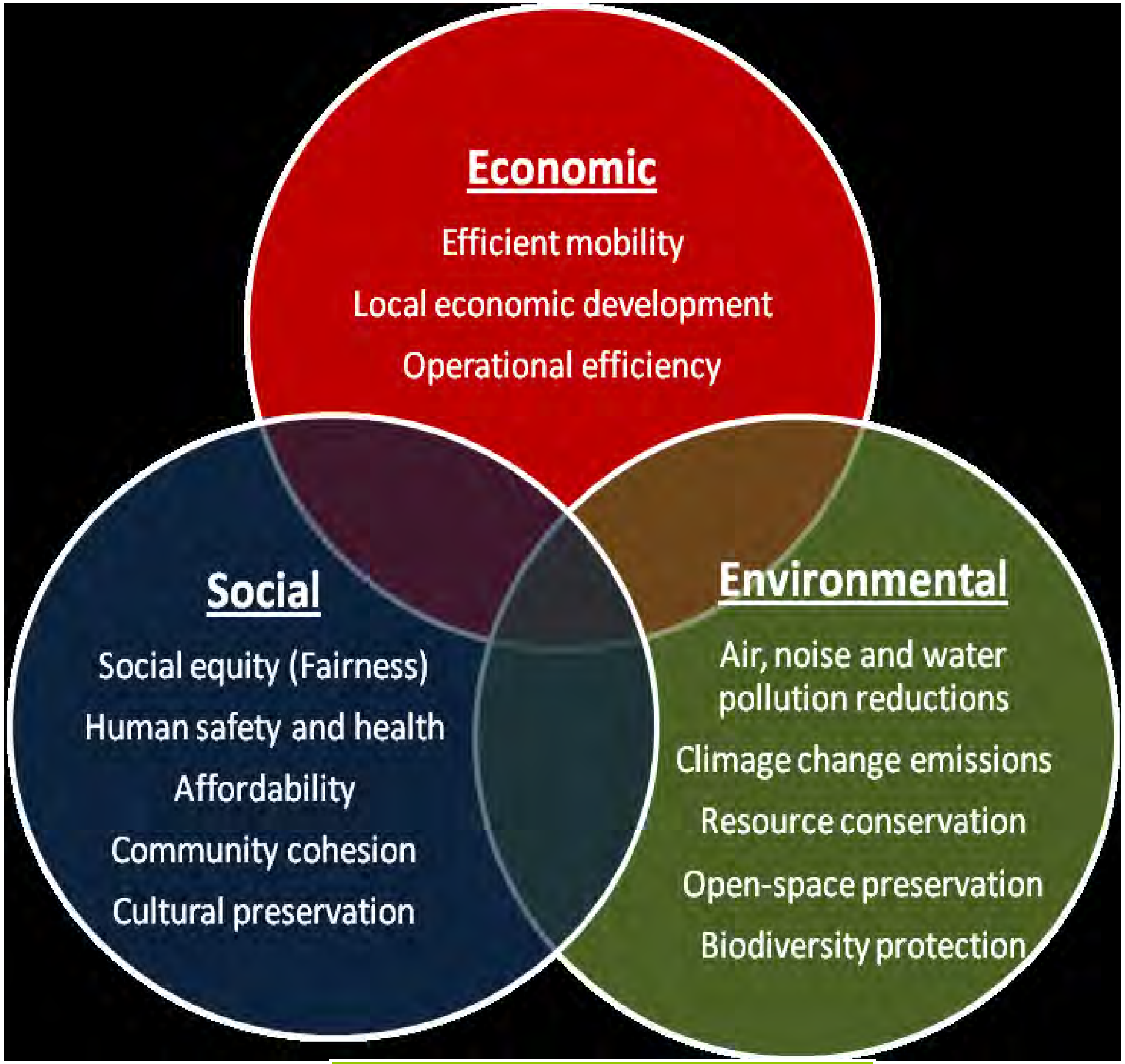
TRANSPORTATION

- Walking is more prioritized
- Two wheelers and public are the major means- accessible to all streets
- Rate of flow of traffic is almost negligible
- Public bus available at every 30 mins
- Route- two route(Khokana to Ratna park, Khokana to Lagankhel)

Sustainability	Walking	Public	Private
Social	Community interaction, healthier,	Community interaction, bus stand at an accessible distance	Access to every streets
Environmental	No air pollution	Less air polluted	
Economical	Best option	Economical	

)

TRANSPORTATION SUSTAINABILITY



Sustainable Transport
Source:-(Litman, 2015)

Khokana bus stop

Motorable road

Pedestrian way
(Stone /brick)

Stone paved on both
side & middle open

ENERGY

Electricity, Renewable Energy, Passive Design, Energy Efficient Technology.

ELECTRICITY

- NEA electricity supply line
- Luminaires: Incandescent, Fluorescent, CFL, LED
- Street lighting – Inadequate
- No solar PV cells used
- Use of inverter for electricity back up.

Renewable energy

- Lack of use of renewable energy like biogas, solar PV cells.
- Use of wood fuel.

Passive design

- Traditional homes have elements of passive design.
  - Courtyard for natural lighting, ventilation.
  - Bricks (*kachhi appa*), timber and mud mortar provide thermal insulation in the building.
  - Water bodies like hitis and pond maintain thermal balance.
  - Open jointed brick and stone pavement allow water discharge.



Energy Efficient Technology

- Use of CFL lamp to some extent.

DESIGN OF SOLAR PV AND SOLAR WATER HEATER

RESIDENCE 1

Reason for selection: Contemporary type building with large number of house members
Owner: Mr Samir Maharjan
Family Members: 10

Solar water heater

- **Amount of water consumption per day: 400 ltrs. (Max)**
- Required water temp: 30^0C
- SWH can raise the water temp to 57^0C (Average maximum temperature raised in SWH collector in Kathmandu valley)
- Cold Water inlet temperature = 10^0C(water temperature normally does not fall below this temperature)
- Calculating the hot water reserve tank using energy equation gives 340 ltrs.

collector	*area*	*reservoir size*
3.0 m²	**(2 panels)**	**150 l reservoir**
4.5 m²	**(3 panels)**	**250 l reservoir**
7.5 m²	**(5 panels)**	**400 l reservoir**
10.5 m²	**(7 panels)**	**600 l reservoir**

Solar PV Design

Particular	Quantity	Power (Watt)	Daily operation (Hours)
Electric lamp Incandescent	5	40	4
Electric lamp LED	5	3	5
Radio	1	3	1
Television LCD	1	70	7
Total		116	

TOTAL DAILY ENERGY REQUIREMENT

$$I_M = \frac{E}{H_P \times B_V}$$

- E = 875 Wh + 3 Wh + 490 Wh =1368 Wh
- **Normally for Nepal, solar insolation is 4.5 kWh/m2/day (or Peak Sun of 4.5 hour).**
- Current generated by solar module

Contd..

- 12 V battery is used in the solar home system,

$$Im = \frac{E}{Hp * Bv}$$

$$= 1368/\ 4.5 * 12 = 25.33\ Ampere$$

Selection of Battery : 855 Ah

$$C_B = \frac{E}{\eta_B \times DOD \times B_V} \times N_A$$

Selection of Charge Controller

- Maximum load current 9.6A

$$I_{L\max} = \frac{P_T}{B_V}$$

Size of Solar PV

- An array able to produce 20 to 24 kWh of electricity every must be 4 kW or larger (based on 5 sun hours per day). So for 1.37kWh**, array able to produce must be round 275 W.**

PANEL NAME	WIDTH (IN.)	LENGTH (IN.)	WATTS	WATTS/SQ. FT.
BP Solar BP175B	31	62	175	13.1
Evergreen ES-B-180	37	62	180	11.3
GE GEPV200	38	58	200	13.1
Kyocera KD-180GX-LP	39	52	180	12.8
Kyocera KD-205GX-LP	31	59	205	16.1
Sanyo HIP-195BA3	34	52	195	15.9
Sanyo HIP-200BA19	34	52	200	16.3
Sanyo HIT Power 205	34.6	51.9	205	16.4
Sharp ND-208U1F	39	65	208	11.8
Sharp NT-175UC1	32	62	175	12.7
Solarworld SW175	31	62	175	13.1
Suntech STP180S	31	62	180	13.5
AVERAGE:	34	58	190	13.8

So from these data, around 20 Square feet area(if Commercially available)is needed or two panel must be installed.

DESIGN OF SOLAR PV AND SOLAR WATER HEATER

RESIDENCE 2

Reason for selection: Traditional house with courtyard

Owner: Mr Mana Kaji Maharjan

Building type: Residential

Since this house uses in-efficient bulbs so for solar design we recommend LED bulbs and solar PV only for lighting purpose.

Particular	Quantity	Power (Watt)	Daily operation (Hours)
Electric lamp LED	5	5	5
Total		5	

the total energy consumption for lighting lamps is 125 watt

array able to produce must be round 25 W.

SWH Design

Required water quantity = 50 liters per person.

Recommend: 37.03 liter * 2 person =nearly equals to 75 liter hot water storage tank system

Fig: Enclosed courtyard for light and water discharge

Fig: Use of incandescent light

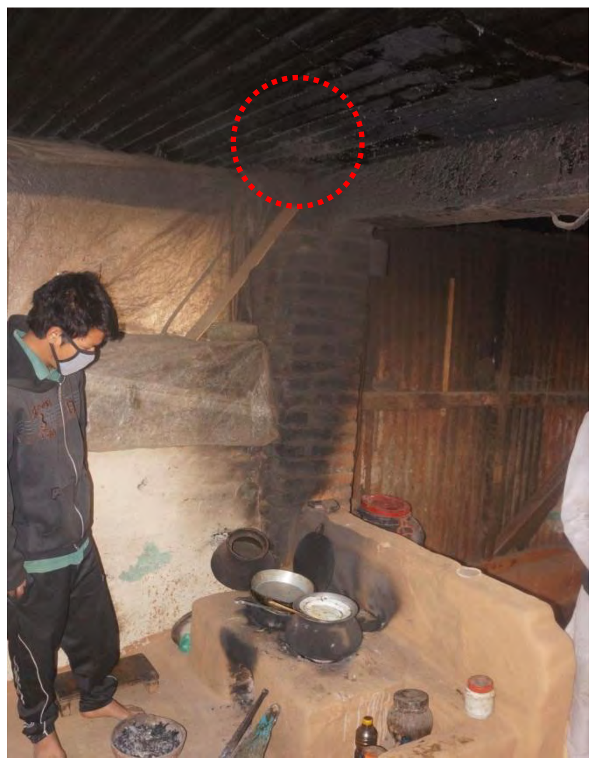


Fig: Hole in CGI Sheet functioning chimney

RECOMMENDATION

- People should be made aware about the richness of their culturally driven traditional settlement.
- Eco tour route covering the major elements of uniqueness of Khokana can be proposed.
- A user participatory approach in policy making is required.
- Proper building code can be implied to at least conserve the traditional streetscape.
- Modern new houses should be encourage in applying the passive design techniques
- Awareness on the use of more energy efficient technology is necessary eg- improved cooking stove, LED bulbs etc.
- Private museum- can be a good example for economical sustainability : THE FIRST HOUSE PROVIDED WITH ELECTRICITY IN NEPAL

CONCLUSION

- Change in lifestyle and intervention of modern technology - traditional identity is in risk
- Khokana is the identity of traditional Newari settlement and is unique in itself.
- It can prosper with tourism and tourism can flourish with proper planning and conservation
- Policy makers along with the local inhabitant need to take step otherwise THE IDENTITY OF KHOKANA IS IN RISK!!

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Sustainability Assessment of a Traditional Settlement at Khokana

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ABSTRA

This report describes the historical background, sustainability aspects in terms of eco-city, land use and energy efficiency, and some recommendation of the sustainability practice of Khokana village. For that this report initially describes the introduction of Khokana village. The objective of the study was to analyze the elements and practices of the settlement in terms of sustainability, to assess the settlement pattern and land use on the basis of existing physical infrastructure for analyzing its social sustainability and to assess the energy consumption pattern, solid waste management of the town and its impact on the environment. Exploratory and Descriptive type of study methodology was adopted for which focus was made on literature and observation as interviews, sketches and photographs. Study was divided in four characteristics: physical, socio-cultural, economical and energy efficient characteristics respectively. Land use, Built form, streets/transportation, open space, water bodies, infrastructure and energy were used as the analysis parameter. And at the conclusion this report compares the present scenario and future potential for ecocity and sustainability.

ACKNOW

The project was gestated for numerous time. We take this opportunity to thank many assisting teachers who would ignite our lost enthusiasm. In the course of this study, a lot of local people have provided help and support without which this report would have been complete. So, we would like to give our heartfelt thanks to all those people who have helped us directly or indirectly.

Nothing in this world is accomplished alone, and we would like to thank those who have highly supported us to accomplish this project. We would like to thank our program coordinator Assoc. Prof. Dr. Sushil Bajracharya for introducing us to this interesting and knowledge gaining project. We would also like to thank Assoc. Prof. Dr. Sudha Shrestha & Assoc. Prof. Sangita Singh for their continuous guidance regarding the sustainable planning. Further, we are thankful to our external jury for his valuable suggestion. We are thankful to inhabitants of Khokana for supporting us and providing us with the valuable information. They provided ‘the goodies’; they welded a difficult segment; they surface-finished flawlessly our most tiring job; they painted the finished job, they turned the blocks of wood; they taught us the trick of their trade. Our bouquet of thanks also includes to our other friends who would expend themselves to pull, push, shove, lift, try, open, close, start, ideate, and catalyze this endeavors.

TABLE OF CONTENTS

PREFACE

This project of assessing the sustainability of a traditional settlement, Khokana village was given as part of our seminar project on Sustainable Energy for Urban and Rural Planning. We were thus entitled to do the observation of the settlement regarding the major three factors of sustainability, namely; social sustainability, environmental sustainability and economic sustainability.

The present trend of urban transformation in Khokana and the development pressure induced by the growing urbanization of Kathmandu valley are likely to bring a rapid change in the area. With the increase in use of modern type of houses and with the rapid urbanization, many villages, previously famous for their sustainability, are turning into unsustainable habitat for living. So this report has tried to assess different aspects of sustainability and try to recommend different measures for preventing the unsustainability of Khokana village.

INTRODUC

BACKGROUND

The urban system of Kathmandu Valley comprises of not only larger cities like Kathmandu, Patan and Bhaktapur but also consists of several small specialized settlements; these settlements were well known for their specialized production. For example, Lubhu for Textile, Thimi for Pottery, Khokana for Oil.

Khokana was an industrial-service town of the valley and was famous for its mustard oil production. It used to serve whole valley with its rich mustard oil. Likewise, Khokana also reveals an excellent example of the unique clustered Newari settlement, which is still able to retain its traditional image; it exhibits outstanding built and open spaces which is typical form of traditional settlement of Malla period. The number of lavishly decorated brick houses with magnificently carved windows of typical Newar craftsmanship, the street paving, and urban spaces in the form of chowks, courtyards and efficient water collection system are signs of a prosperous past. Socio-cultural activities, Jatras and untouched tradition of the community are few of the major attractions not only for domestic and international tourist but also to historians and anthropologists, its close relationship with agriculture, socio cultural activities, built heritage and its urban form, demonstrate its original character and exhibits as a cultural heritage of the valley.

However today, this traditional settlement of Malla period which is regarded as “Gem of Civilization” is declining and loosing its character with the growing urbanization of the valley. In modern times, the urbanization in Kathmandu Valley started from mid-fifties and has picked up with alarming rate in last thirty or more years. This has led to an unprecedented rural to urban migration in the valley. The consequence is the haphazard growth and urban sprawl, resulting loss of agricultural land and high infrastructure cost.

Being located in close proximity to the capital city and Lalitpur Sub Metropolitan city, the seeds of urban transformation are already planted in Khokana. This is manifested from the physical and socio-economic changes that are taking place in the area. The socio-economic pattern of living has changed considerably as could be seen clearly from the family structure, occupational change, literacy rate, modern amenities in the households. However, the physical transformation in built form is very slow except few changes in access, road width, building volume, building style etc.

Earlier the economy of Khokana was based on agriculture; land was fertile, food plentiful and the society affluent. But today very few percent rely on agriculture; others are in services ad business. The ground floor of the traditional Newar house which served as the cattle shed and for storage of food grains caters to other needs today. It is seen that most people living in the core area belong to a weaker economic group. Their total saving is very less, so they are forced to give their houses on rent. Majority of the house-owners have given their rooms for rent. Because of the economy only, the people are attracted to the commercial activities. Along the street, shops have come up haphazardly. People are extending the building vertically spoiling the scale and skyline. Due to the commercialization of the place vehicular movement has been increased. The existing street pattern was designed for pedestrian movement only. The width of the streets was determined by the width of the 'wheel axes' of religious chariots.

The various parameter of sustainability however have existed unknowingly in the past especially in the culture driven traditional societies of Kathmandu valley. Therefore, this study will seek to analyze the elements and practices of the settlement in terms of sustainability on the basis of present settlement pattern, land use, physical infrastructure, energy consumption pattern and solid waste management. This study will also try to look at some recommendation to the ongoing transformation so that it can absorb development pressure with out intervening the image and vitality of the historic town.

PROBLEM STATEMENT

In the early days, when oil business was in boom, Khokana was a prosperous town. But in due course of time, the oil production is in verge of decline. With the advent of new modern technology, varieties of products and high competition in the market, most of the old oil mill has closed. As it lost its primacy, the economic opportunities also declined. Overall the socio-economic condition of Khokana is getting poorer.

Looking at the present scenario, with the modernization of the area, the livelihood and life style of the local people is changing, this could be well reflected by –changing process of occupation, reduction in agricultural land holdings, increase in settlement, new buildings and built form, increasing use of modern amenities etc. This shows that the urban transformation is already taking place. However, there is still a marked deficiency of infrastructures. Poor solid waste management system and pathetic sanitation is clearly evident. The condition of road especially within the core area is not good. Most of the buildings are not suitable for living.

OBJECTIVES

The main objectives of the study are:

a) To analyze the elements and practices of the settlement in terms of sustainability.
b) To assess the settlement pattern and land use on the basis of existing physical infrastructure for analyzing its social sustainability
c) To assess the energy consumption pattern, solid waste management of the town and its impact on the environment.

METHODOLOGY

Since, the objective of the study is to analyze the existing elements, practices, the energy consumption pattern and solid waste management prevailing in Khokana in terms of sustainability, the study methodology employed was exploratory and descriptive which was based on both literature and observation. Therefore, both qualitative and quantitative approach has been considered in the study. For this the study was distinguished into four characteristics of Eco-city and sustainability which are physical, socio-cultural, economical and energy efficiency. For this different analysis parameters such as land use, built form, transportation, open space, water bodies, infrastructure and energy were used and interpretive-historical method of research was applied.

PHYSICAL CHARACTERISTICS

Khokana, a dense Newari settlement is situated on the south-west part of Lalitpur Sub-metropolitan City almost on the south-west edge of Kathmandu valley. It is situated at about 6 km from the city area. The VDC is bounded politically in the north by Sainbu VDC and Kirtipur Municipality, in the south by Bungamati and Setidevi VDC, in the east by Bungamati and Sainbu VDC and the famous Bagmati River.

Khokana's geographical setting is overlooking to the west direction. It has a steep slope towards west, whereas the main settlement is located on a tar (elevated) land, with plain land or slopes virtually separated physically for the agriculture. Total land occupied by the VDC is 3.47 square kilometers—whereas the ancient settlement covers only about 0.20 square kilometers. More than 90% of the total land is covered by a very beautiful setting of agricultural fields.

The altitude of the VDC is 1260 to 1335m from the mean sea level. The VDC lies between the latitude of 27°38′30″ and the longitude of 85°17′20″. The annual relative humidity is 60-90%. The annual average rainfall in the village is 1250mm with the average maximum temperature of 31°c in summer and the minimum temperature 1°c in winter.

CULTURAL CHARACTERISTICS

The major deities of Khokana are Rudrayani, Shikali & Bhairab. The main temple is a two tiered construction dedicated to Shekali Mai – a mother goddess. The temple of Rudrayani is the major religious site but ponds have also equally religious importance.
An interesting and distinct culture that one finds in this city is the absence of garlic and hen. In Khokana, the people neither rear nor consume chickens and garlic. At present also, chickens are not seen on the streets. Domesticating ducks, sheep and goats is very common there instead of hens.

ECONOMIC CHARACTERISTICS

The people living in the core area are weaker in terms of their economic condition. The economy of Khokana is based on the agriculture. Majority of the population is involved in agriculture in this village. Khokana people do not keep poultry and do not have chicken and eggs because of their typical cultural belief. Animal husbandry is limited to sheep, goat, ducks, cow, buffalo and pigs. Besides agriculture few heads of these households have services, and yet lesser numbers have business as their occupation.

Women are also active in economies activities in Khokana. Leisure time from agricultural work most of the women are engaged in weaving, wool works, making straw mat and carpets from agricultural and livestock waste like hey, straw, wool etc. Most of traditional cottage industries are performed during free time at day after finishing household works.

- Women involved in weaving, wool works, making straw mat, carpets- Recycle of agricultural waste- ecological sound economic activities
- Specialized in mustard oil production

ELEM

LAND USE

At the physical level, the Newari rural settlement has always been compact and well defined through boundaries that have been traditionally set. The traditional morphology of Khokana represents a hierarchy of public, semi-public and private open spaces, which is typical of a Newari Settlement. They are defined by built forms of different types and linked together by a hierarchy of network of streets.

The land use can of Khokana can be defined by the mixed land use comprising of the built forms like residences and temples, the open spaces and water bodies like the chowk, courtyard, forest, agri-land and ponds, hitis and not to forget the streets interlinking the chowks to the residential courtyard and the agricultural land.

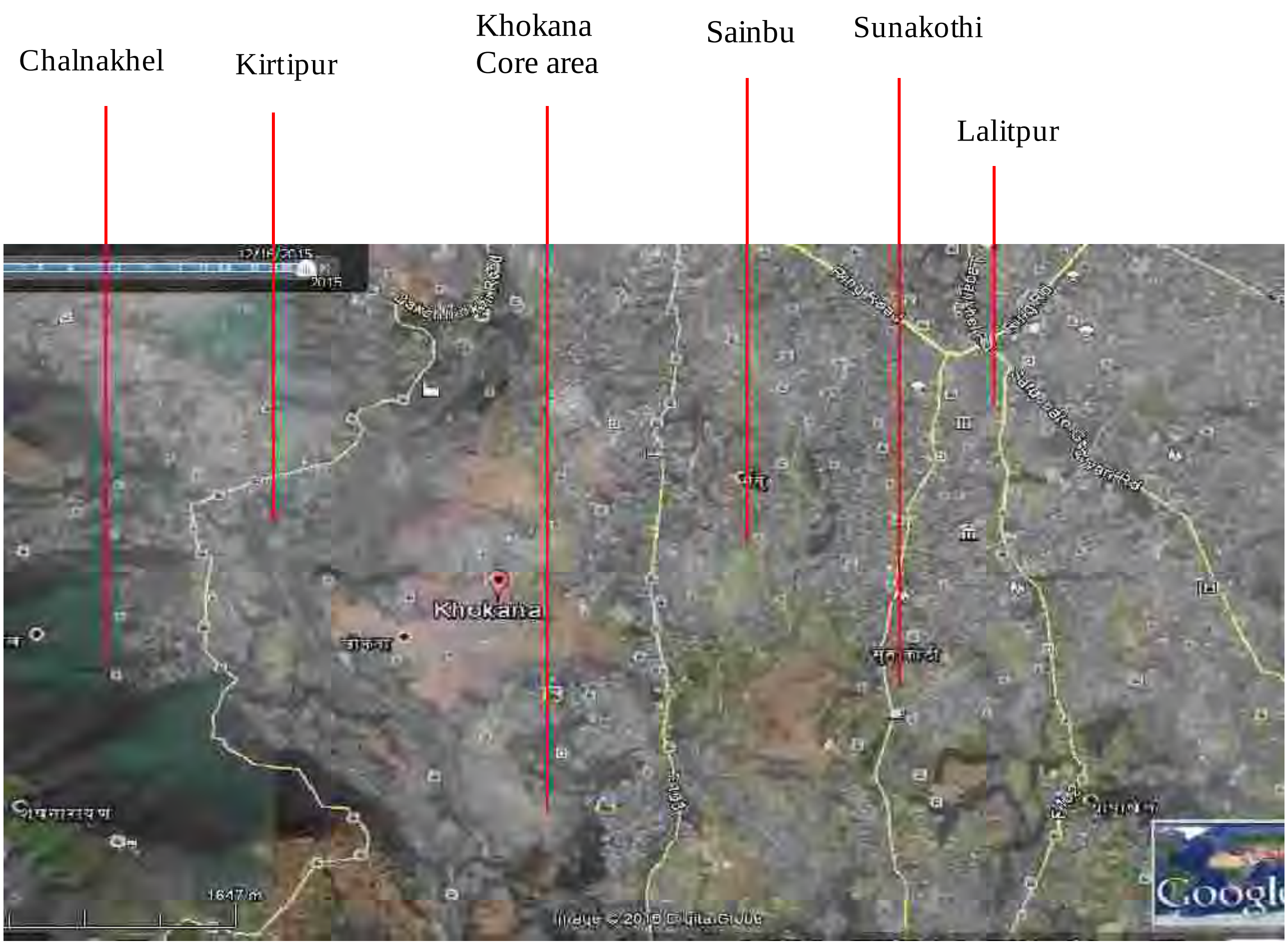

Fig: Illustration of surrounding of Khokana at appx. 5 km
Source: Google Earth

2003

2007

2011

2015

Fig: Trend of change in land use pattern from 2003 to 2015

Source: Google Earth

Fig: Urban Sprawl towards South-East and North-West

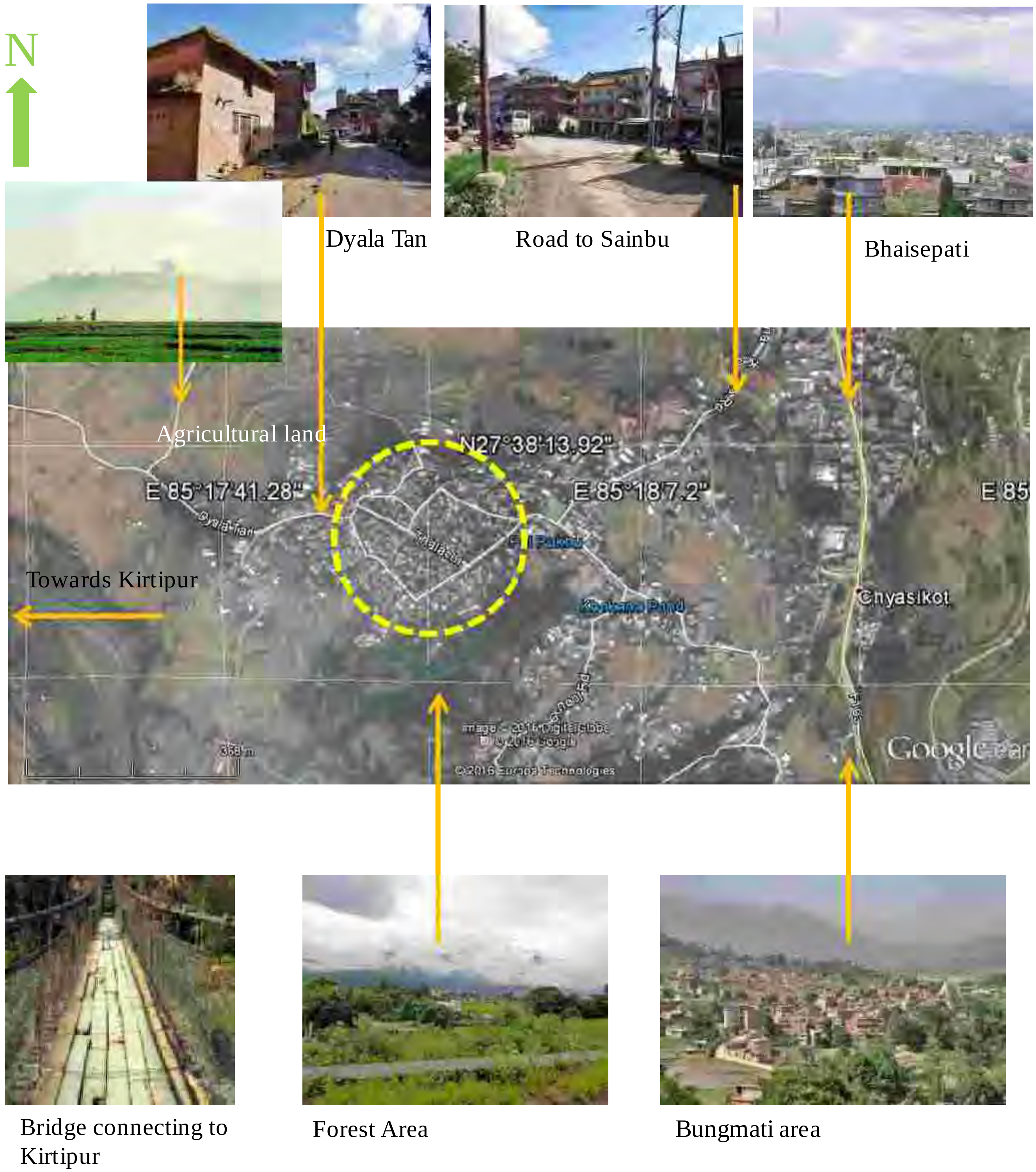

Fig: Illustration of surrounding periphery at appx. 2 km

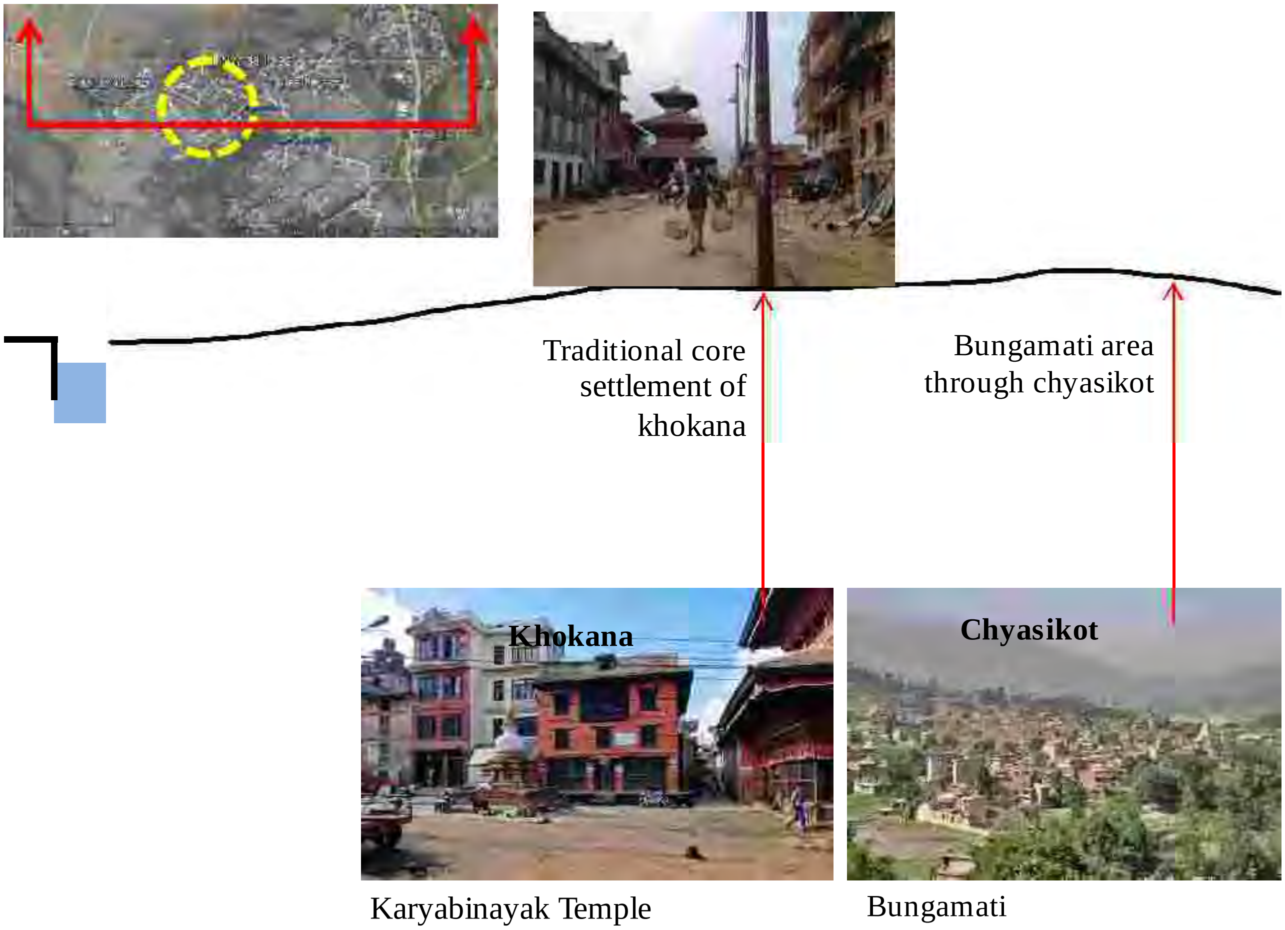

Fig: Longitudinal section of Khokana and Surrounding

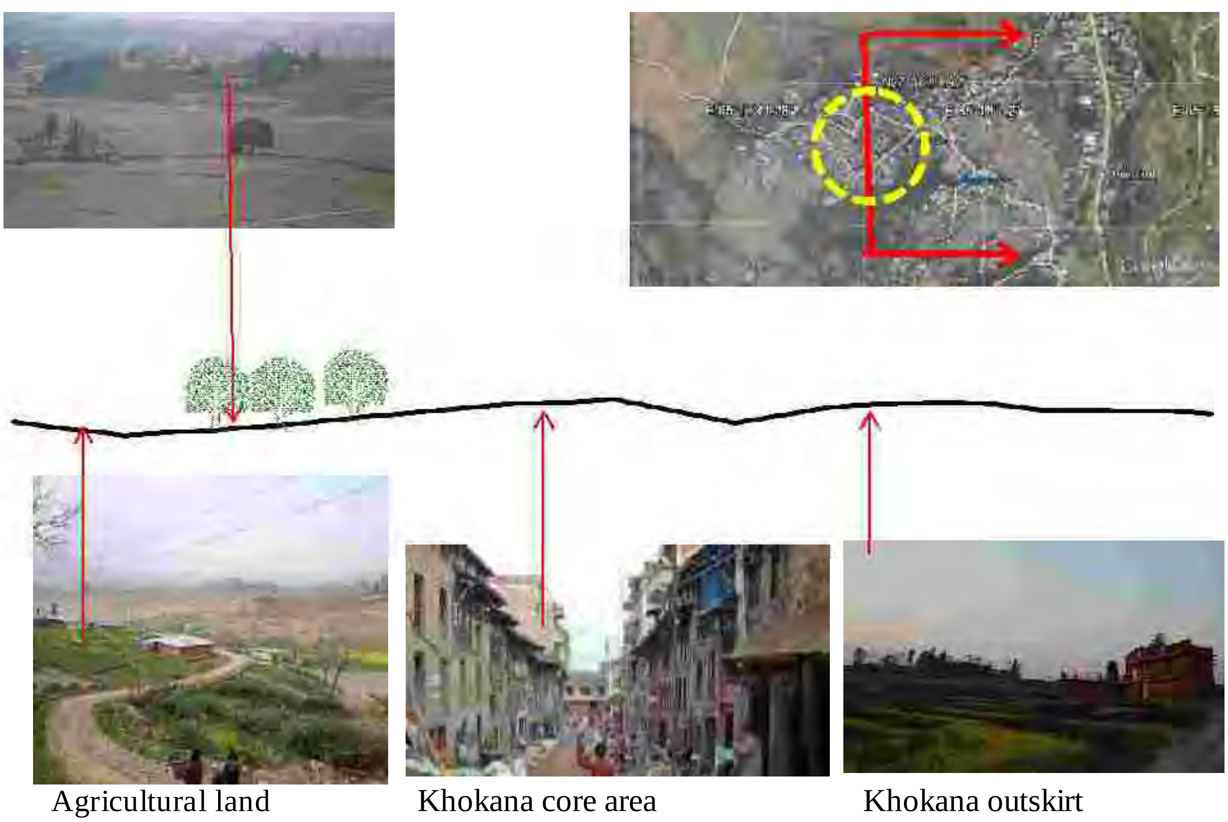

Fig: Transverse section of Khokana and Surrounding

Fig: Land use of Khokana core area and its peripheral surrounding

Fig: The green periphery of Khokana core city (Google Map of 2015)

Fig: Khokana Main street

Fig: Khokana sub street

Fig: Approach from Sainbu

Fig: Khokana Dyala Tan towards Dhokasi

Fig: Kha Pukhu

Fig: Illustration of land use pattern focusing on scenario of streets of Khokana core area

Fig:Towards Ghokasi

Fig: Rudrayeni Temple

Fig: Dyo Pukhu

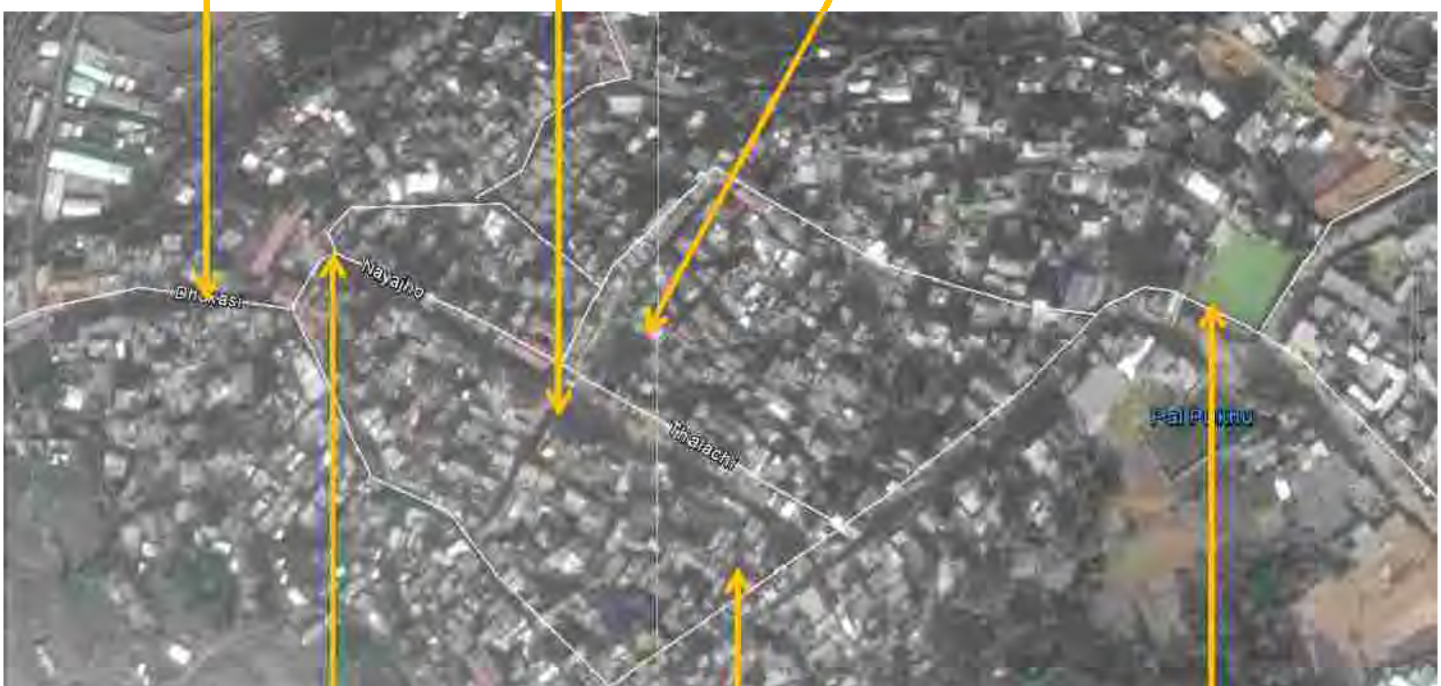

Fig: Guthi

Fig: Illustration of land use pattern focusing on traditional features of Khokana core area

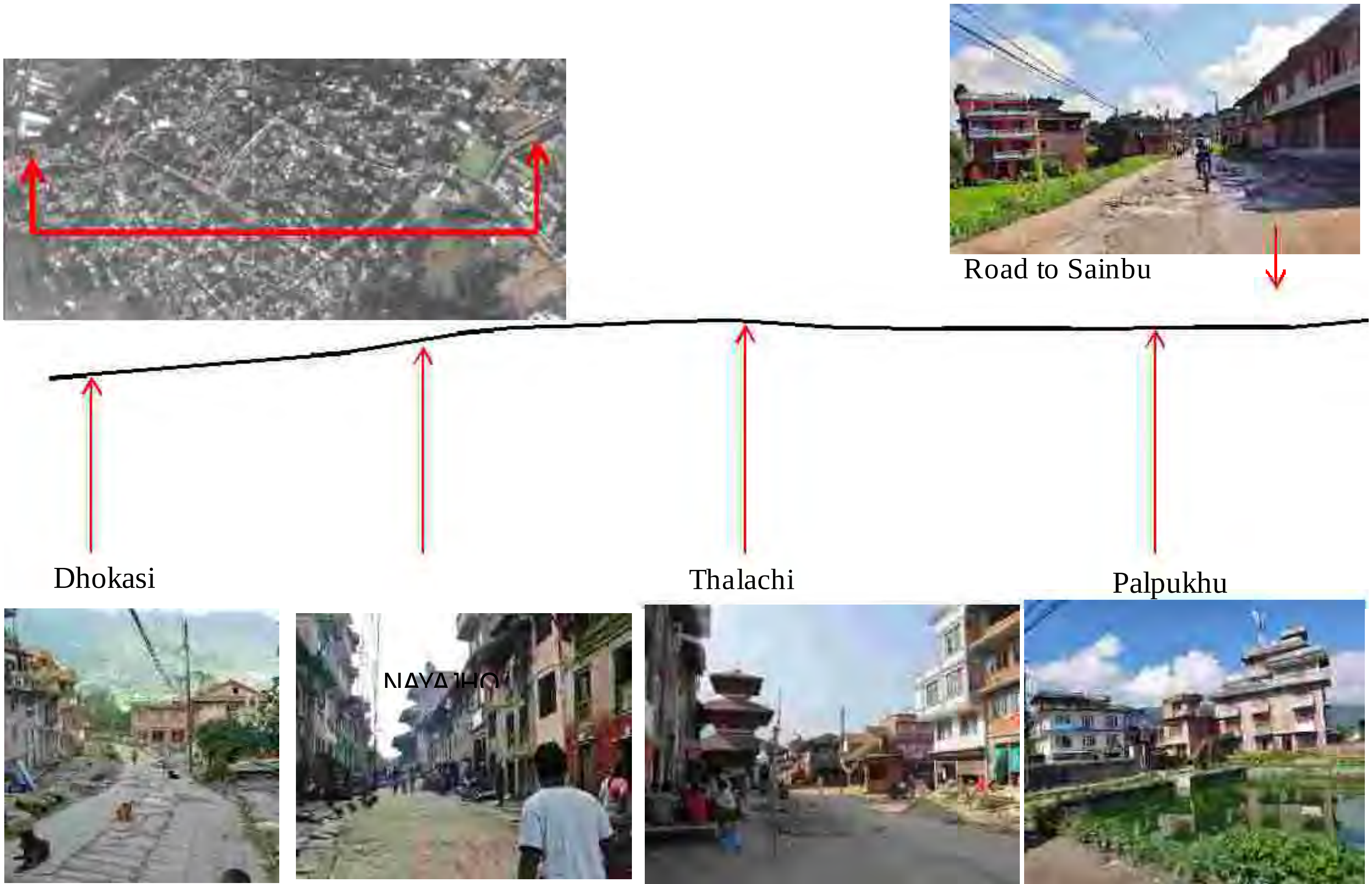

Fig: Longitudinal section of Khokana core area

Fig: Transverse section of Khokana core area

Scenario after EQ 2015

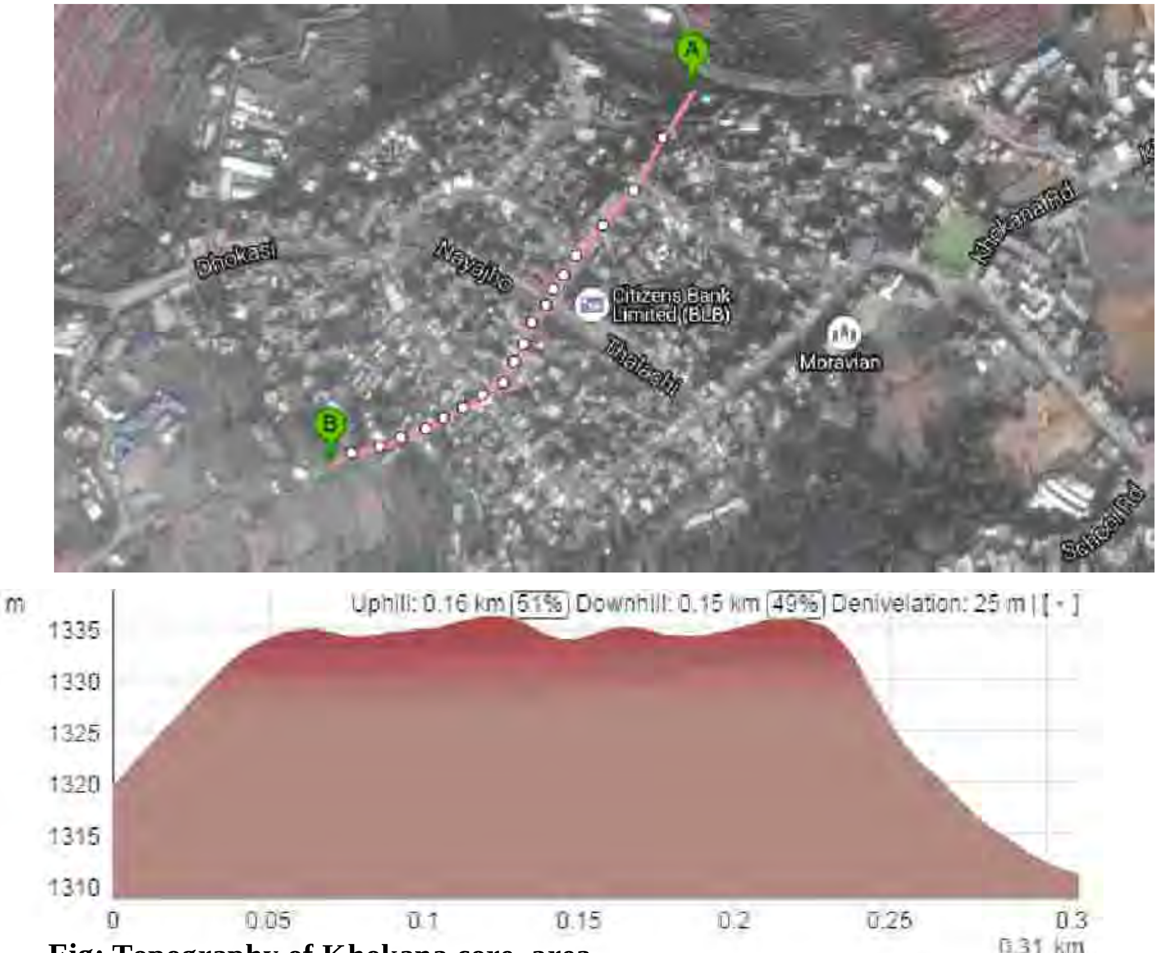

Fig: Topography of Khokana core area

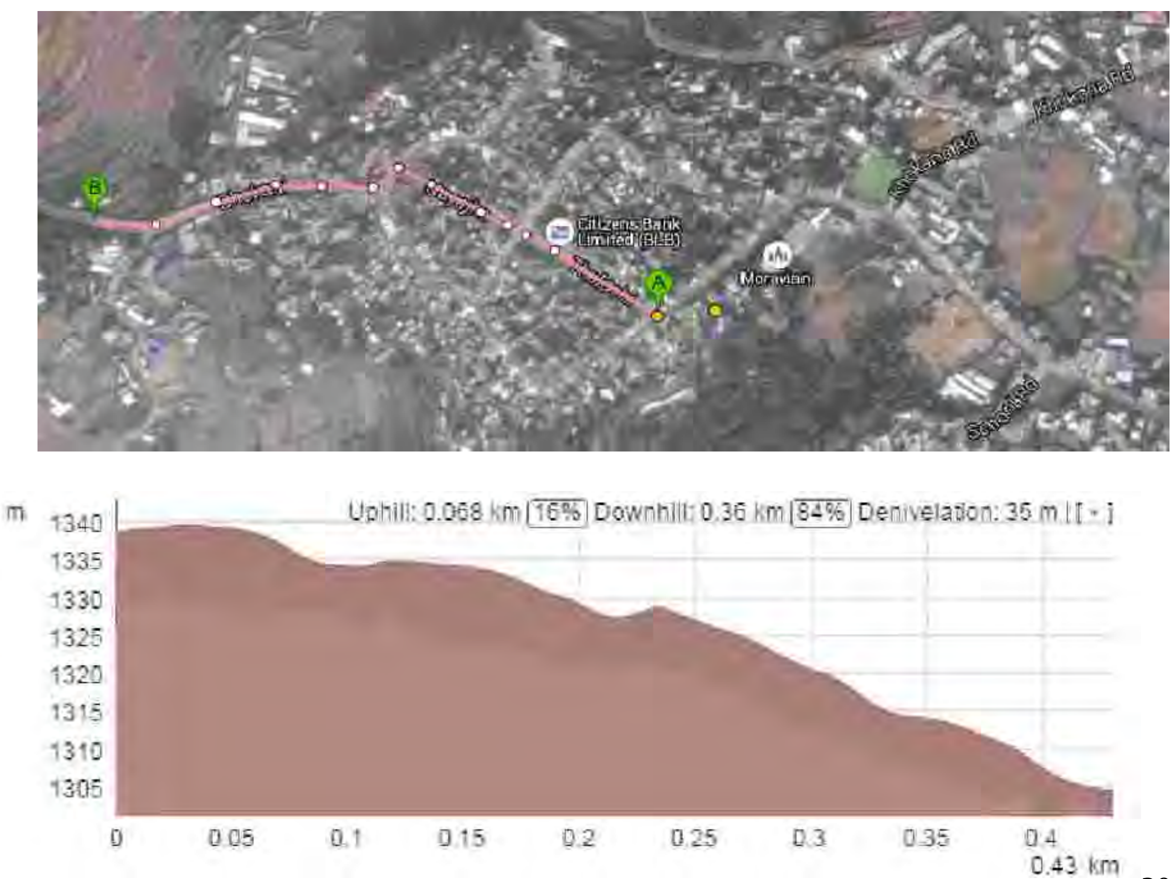

Fig: Topography of Khokana core area

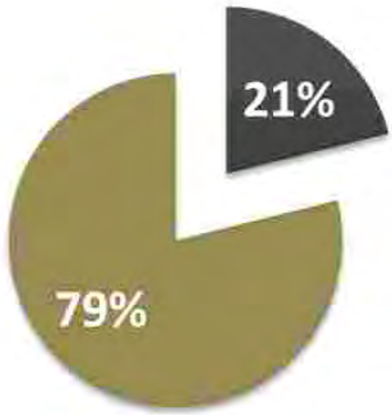

Fig: Area Occupied by road

Fig: Area Occupied by water body

Fig: Area Occupied by built up area
Source: Khokana Basemap

Fig: Ratio of old and new houses
(About 80% traditional houses
destroyed after recent EQ)

Fig: Location of Public Wells in Khokana core city area

Fig: Location of Oil Mill in Khokana core city area

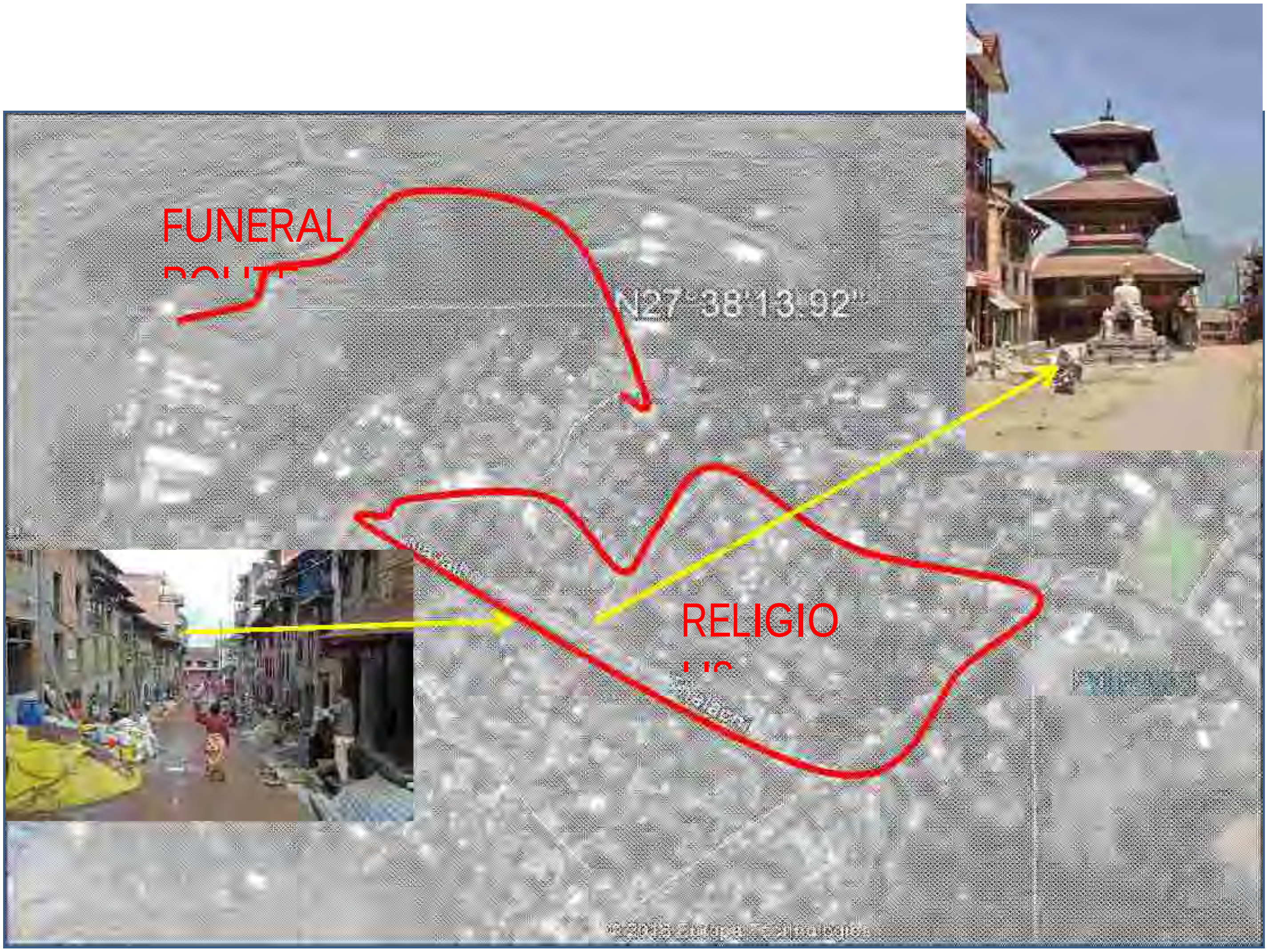

Fig: Religious route of Khokana core area

Fig: Distance to periphery from Khokana core area

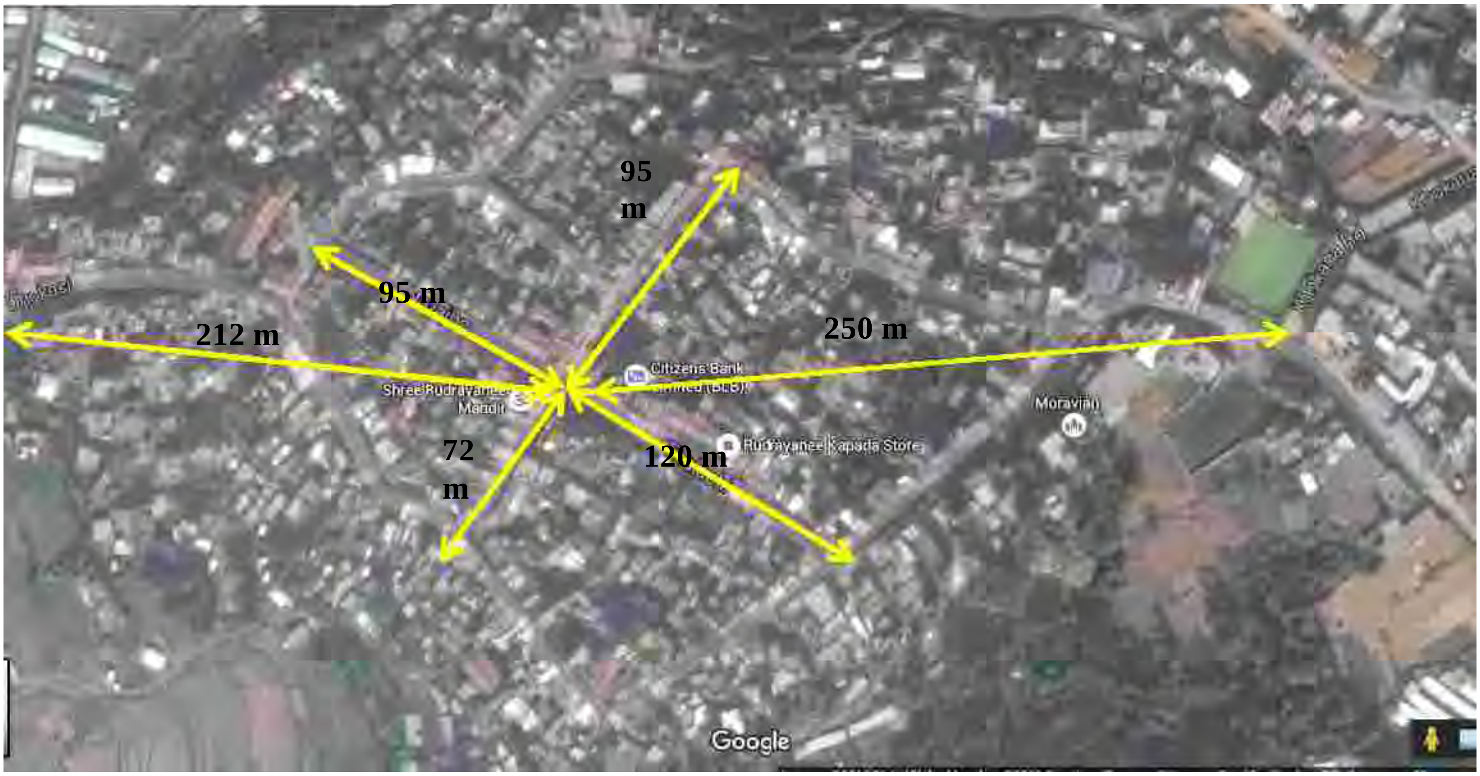

Fig: Distance to the the peripheral area from center of Khokana core area

Fig: Distance to the educational buildings from center of Khokana core area

Fig: Distance to the health post from center of Khokana core area

BUILT FORM

Khokana has been found to have a mix type of residence comprising of purely traditional, RC structured and the combination of both. There also existed few temporary houses built in the surrounding of the core after the deterioration of the houses because of the recent earthquake. The purely traditional houses are not architecturally beautiful but also provide thermal comfort. The materials used in these houses like sun dried bricks, the mud mortar, the wooden beams and posts and the jhingati tiles are locally available and constructed. Therefore these indigenous materials are affordable. Therefore the traditional houses also accept water and they are non- hazardous when destroyed.

Though the joint family system is quite prominent in the Newars, it is fading away. The disintegration of the extended family leads to the division of the household. It is seen that the division is always vertical and since the space need multiplies the extension of floors becomes obvious. This result finally has affected the urban built form in terms of appearance of façade around or along with it.

With the advent of modernization, there is a marked change seen in the physical built space of the study area. Today majority of the traditional buildings are replaced by Modern RCC construction with large glazed windows, flats roofs and plastered façade. In the past the average Newar house was 3 storied. But today the majority of the houses in the inner city are 4 to 5 storeyed. This is due to the modern construction technology. In the process it has completely spoiled the skyline and streetscape.

After the major earthquake on 12 Baishak 2072, the periphery of the core area has been encroached by the temporary shelters housing the people whose house was destroyed.

Residences

The main feature of the façade lies in the symmetrical arrangement of traditional wooden carved windows with or without balconies. The ground floor consists of either shops or small-carved doors. The first floor has a series of odd number of carved windows having wooden trellis/lattice for cross ventilation similar in opening- span to the ground floor door. The top floor consists of large carved windows often sloping up and out to meet the projecting roof or just straight, which is known as SA- JHYA OR GA- JHYA, which lends an air prosperity and visual participation with the street. Another main feature of the façade are the exposed brick walls and the plain wooden brackets jutting out of the wall. They are meant to support the hanging eaves of the roof and drain the water from the roof off the wall. There is generally a single doorway, which is sometimes profusely carved.

There are two basic materials for construction of traditional Newari buildings, namely mud and wood. Mud is used as mortar, bricks and tiles and timber as posts, joists, rafters, struts, doors and windows. The structure system of the walls is always loaded bearing and 30- 45 cms thick. The roofs are sloping with the wooden rafters supporting the joists and beams, which are laid over by a thick layer of mud and tiles fixed over it. The jointing system for wooden fixtures including doors and windows is mainly tongue and grooved. This type of wood reinforced masonry construction can absorb small earthquakes and give the houses enough strength to counter such situations. Windows and doors have small openings in the wall, constructed with two lintels, one at the top and another at bottom forming a part of the wall construction. The whole structure rests on brick- stone foundations and the plinth is made of rubble stone masonry.

Most of the houses have added one floor to their houses to incorporate increasing family size. This is mostly done when the family size reaches a stagnation point even after vertical division. However, vertical division is essentially the first step in introducing structural changes in the traditional houses. In case of additions of floors, the sloping tiled roofs are reintroduced but in many cases, flat terraces built in reinforced cement concrete are increasingly replacing them. It has destroyed the traditional uniform skyline of buildings.

There is gradual change from sun dried to baked bricks and from mud to lime or cement mortar. There is also a change in external finishes and the exposed brick facades being increasingly plastered in cement and white washed. The tiled roofs are being increasingly replaced by tinned roofs or reinforced cement or brick concrete flat slabs. In many houses, iron railings are added on the terraces.

Courtyard and Chowks

The living and their routine movements primarily include performing daily religious rituals such as bathing in the rivers or sacred ponds, offering daily pujas to various gods to set the tone of the day, going to the farms and coming back, going to the market to buy/exchange items of the mundane necessities and the like. These generate the patterns linking rivers, ponds, temples, farms and the markets to the residences.

Earlier when the house was in its original form it responded well to the climate. It is noticed that the height of the building and the depth of the courtyard were equal and the orientation of the courtyard was north –south.

Indeed almost all Malla towns were sited on the non-agricultural ridges along various rivers primarily to meet such requirements. As mentioned earlier, Khokana was also situated along holy Bagmati River at Kudesh. Only later, it was shifted to the present location. The town was farm lands all around the settlements and across the rivers causing the growth of radial streets to rivers and farms. These streets join together as they reach into the town. Such nodal points were developed into chowks or Lachhis with increasing social importance, as they get closer to the center nodal points, where all the activities also converge. This type of square houses public religious edifices such as a temple, ponds and water spout.

Street

It is already mentioned above that the generation of movement pattern in Khokana is due to religious functional requirements of the inhabitants. So the hierarchy of the street pattern of Khokana can be classified on the basis of function, scale and the variations are not on the basis of width of the street which is as follows:

1. MAIN STREET: It is where all the major social and religious functions and activities take place. It links the central chowk to various community chowk. As the main connecting axis, it threads its way through the whole township.
2. ARTILLERY STREET: These link the community chowk to the residential courtyards; some of these streets also continue onto the farmlands in the open.

Since the Newari people have a strong communal life, the inhabitants use the house only as a place in which to sleep, store things, and raise animals, and most living takes place outside their houses. The town compensate for lack of private spaces by ample public space, where the women, in particular, socialize with each other. The courtyard and streets not only provides light and ventilation but it also provides playing area for the children, place for social, religious, cultural activities and for drying, washing, bathing etc.

Fig: Street pattern in Khokana

Fig: Vehicular pattern in Khokana

WATER SUPPLY DISTRIBUTION

There are no permanent natural sources of water in and around the village for drinking and cooking purposes. The local people are dependent on the water distributed by the Water Supply Corporation for drinking purpose. Although there are some water spouts in the settlement area, but most of them have dried out. However, few wells are able to cater the demand of water to the local people up to some extent.

Recently for sewerage disposal, hume pipes are laid on both sides of the streets at some places of the core area of Khokana VDC. Due to lack of frequent maintenance and cleaning, most of the sewerage line is not functioning. The untidy solid waste dumping systems have clogged many surface drains.

Water supply system in Khokana are observed in following topics

Source: A sustainable water resource must be able to supply clean and potable water meeting consumers demand. Observation was conducted at Khokana on the basis of traditional source and modern source.

Traditional source of water: Wells, springs, unlined canal (Raj Kulo) contributes the water supply of Khokana traditionally. Almost house has a well which are of shallow type. Wells are dry during dry season with fall in ground water table. Springs, which are natural surface flow, are also dry. But hiti are constructed at the springs so we can conclude there was the water available in past. Agricultural lands are irrigated by irrigation canal. The ancient canal named as “Raj Kulo” was responsible for water supply system of the royal palace. The canal was channeled along the subterranean contour across the outskirts of the settlement. It is believed that the canal provided water for irrigation along the way and was operational till 1970s. Distribution tributaries of canal are unlined. It means there is sufficient water during cropping period. Seepage through unlined canal is higher which can cause soil erosion, landslide with loss of water.

Modern Sources**:** Modern sources consists of water supply scheme for domestic use of water, lined Raj kulo for irrigation purpose and imported water by tanker for refilling the ponds during the time of festival. The drinking water is supplied from Bhainsepati which main spring (source) is at Pharping. This scheme provides water only for 2 hours per week. Water deficiency is problem in khokana. But there is no practice of sustainability like rainwater harvesting or grey water recycling. Due to slope topography water system is designed as gravity flow. Irrigation is done through canal named “Raj Kulo” which transmission length is lined now to reduce seepage and water losses. It carries water from Tikabhairav. The width of the canal is 1.3m deep and 1.5m wide and in most places it runs along the surface until it reaches settlements. It is also believed that ancient Rajkulo canal provided safe drinking water to about 40,000 people in Patan and irrigates an additional 450 ha of farms on the settlement outskirts.

Purpose: The water is consumed for drinking, domestic use and irrigation purpose. Domestic use consists of cleaning, washing dishes, feeding livestock, cooking etc. There is no demand of water for industrial purpose because most of the people are engaged in cottage industries like crafting, oil mills, knitting etc.

Distribution: Drinking water is distributed by pipeline to each house or by community tap. Irrigation water is distributed by canal network spreading in agricultural land. Open drains also contribute water distribution from which livestock like ducks, sheep, goat, cow etc. use to feed water.

Recharge:

All street and open spaces are bitumen, stone & brick paved which are the barriers of ground recharge. Water is accumulated in ponds during rain due to slope topography. Most of the ponds are recharge by tanker in festival season. Agricultural land contributes in recharge.

WASTE MANAGEMENT

Waste water Management

According to the prevailing norms quantity of sewer is about 70% of supplied water. The main sources of waste water are kitchen, toilet, rain and cowshed. Grey water comes from washing of dishes, clothes or bathing. Grey water can be recycled or reuse after certain treatment. But there is no any such practice. All the grey water is flooded on road towards lowland. Ponds accumulate rain water, flood or grey water so water in the ponds is very dirty. There is sewer line available for the waste water which runs through roads network to Bagmati River without treatment. The sewer line is also not connected to all the waste water duct of house. Only toilets and road's side drain are connected. The sewer is responsible for polluting other water bodies on which it mixed up.

Solid Waste Management

"Solid Waste" means any discarded garbage, refuse, septage, sludge from a waste treatment plant, water supply plant, or pollution control facility and other discarded material including solid, liquid, semi-solid, or contained gaseous materials resulting from industrial, commercial, mining or agricultural operations and from community activities but does not include animal manure and absorbent bedding used for soil enrichment or solid or dissolved materials in industrial discharges. (Regulating The Burning and Disposal of Solid Wastes)The solid waste management systems have been the worst at Khokana. The solid waste produced from houses and excreta of human and animals are creating problem in the village. Habit of throwing waste along the street in front of houses is creating an unhygienic condition and degrading the aesthetic of the traditional heritage site. It has also disturbed its environmental balance.

Solid waste management observed at Khokana are as follows:

Composting

Organic waste composting is an important waste management practice that can reduce the volume of municipal solid waste and increase crop productivity. A study was carried out in Khokana, Lalitpur in order to develop understanding of different methods of composting for sustainable solid waste management practices. The biodegradable waste was composted through anaerobic (pit) locally known as saga. Organic wastes like vegetables, animal excreta, kitchen waste, plants which are easily decayed are composted for manure. Such materials are deposited daily in saga by the people and kept for until complete decomposition. The compost manure is used as fertilizer in the agricultural land. Composting reduces the environmental impacts of waste and the produced compost is essential for improving soil fertility and structure (sustainable sanitation and water management(SSWM).

Burning

The burning of any solid waste either by open fire or in a furnace, stove or other device. Incineration of waste materials converts the waste into ash, flue gas, and heat. The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas. Generally inorganic solid wastes are burnt because of their non-decaying properties. In observation, inorganic wastes like plastic, rubber, fibers, etc. are separated and burnt in a metal vessel or in pit. Organic matters like wood, straw, hey, plant residue, husk are also burnt to make ash. Thus produced ash is used in agricultural field as a pesticide which is equivalent to potash.

Recycling

Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, a procedure called kerbside collection. In some communities, the owner of the waste is required to separate the materials into different bins (e.g. for paper, plastics, metals) prior to its collection. In other communities, all recyclable materials are placed in a single bin for collection, and the sorting is handled later at a central facility. The latter method is known as "single-stream recycling.

Transforming

In this process solid waste are transformed to other resources by using certain procedures. For example solid wastes from metal industry are transformed into clinker which is good research for cement industry. In Khokana, bones of buffalo, cow, goat, sheep, etc. are transformed into pellet food to serve chicken farms.

TRANSPORTA

Roads are important transportation and communication links; there are some concerns about their sustainability aspects. In particular, while roads have both economic and social benefits, there is concern about their impact on the natural environment. The main environmental issues with roads tend to revolve around greenhouse gas emissions from the traffic they carry. They also have other potential environmental and social effects, such as their ability to impact on natural landscapes and on those who live near them. . Transport is essential for the economic and social development of all sectors as well as for supporting regional and global cooperation and economies. Historically, the development of a transport sector has been an indicator for its economic welfare and success. Adequate, efficient, and effective inland transport systems are important for access to markets, employment, education and basic services critical to poverty alleviation; at the same time, transportation is a major driving force behind a growing world demand for energy and it has a significant environmental footprint. Transport sustainability is controlled by socio-economic, demographic and environmental megatrends, i.e. major shifts in economic, social and environmental conditions that can impact people at all levels and transform societies. (Liu, 2015)

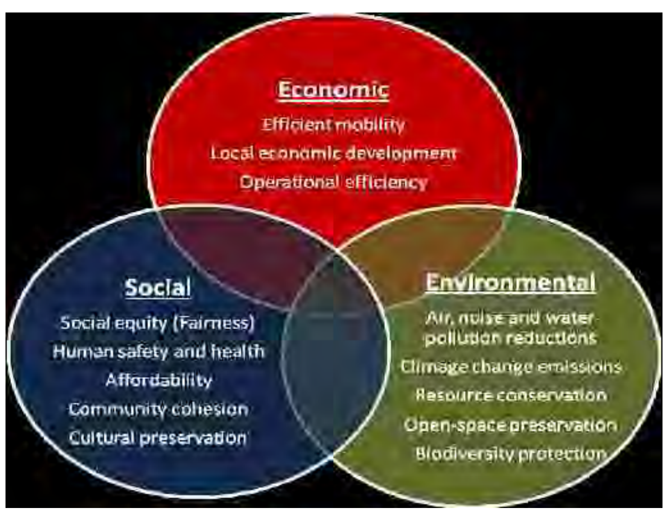

Fig: Sustainable Transport

Source:-(Litman, 2015)

The main component of transportation in Khokana

- Road network
- Road types (According to users)
    - § Motorable road
    - § Pedestrian/Trail
- Mode of travel
    - § Walk
    - § Motor

ROAD NETWORK

Inside the study area there is good networking of road. Roads are earthen, gravel, stone brick and metal road .Most of roads are brick and stone paved which is open join type i.e. good aspect of water recharge and environment friendly. The road is about 2.5m to 3.75m wide which not only provide passage to the people but also act as the space to host the daily activities. Even the road network is to the agricultural land is reach in the sense that all the roads are connected to the field.

Road types (According to users)

On the basis of observation at Khokana, the road types can be categorized into two parts i.e. motor able road and pedestrian road/trail.

Motor-able road

A sustainable motorable road mainly consists of side drain, shoulder, carriageway, super elevation, traffic signal, lighting systems etc. Sustainable transport is safe, high-quality, and accessible to all, ecologically sound, economically viable, and a positive contributor to local, national and international sustainable development. Specific goals for sustainable transport may include: improved service quality and quality of access to goods and services, decreased inland transport related accident and crime rates, improved air quality, noise reduction, improved water quality, protection of natural habitat and open space, historic preservation, reduced carbon emissions, increased social equity, economic development, and a satisfying quality of life, as well as local goals consistent with the overall objective of sustainability. (Liu, 2015)

Main road of Khokana is blacktop which connects to main market of Bhaisepati. But it lacks a separate foot path, proper drain and street lights. Therefore, the main road is comparatively in a good condition yet sustainable Public vehicles run through this road in every 45 minutes interval from Khokana bus stop-Ratanpark. There is networking of road inside the Khokana but public vehicles are restricted to service inside. Only private vehicle enter to internal Khokana .Most of people used public vehicle to go markets such as Kathmandu, Lalitpur, Bhaktpur and other places .Lagankhel is main market of local people for shopping

Fig: Motorable road

Fig: Pedestrian road/Trail

Pedestrian road/ trail

Create and maintain safe, clean neighborhoods and recreational facilities for all. Ensure that public actions are sustainable, while incorporating local values and historical and cultural considerations. Provide adequate and efficient infrastructure (water, sewer, etc.) that minimizes human health and environmental harm, and transportation systems that accommodate broad public access, bike and pedestrian paths. (Litman, 2015)

Inside the study area there is good networking of Pedestrian road/trail road. Most of the roads are brick and stone constructed with open joints in them to take water for recharge of water table. Others are earthen, gravel, and metal constructed.

ELECTRICITY

Khokana has the privilege of being the first area to be lit with electricity in Nepal. The condition of electricity connection is pretty good. But most of the tradition houses use inefficient energy technologies such as the use of incandescent lamp, use of wood fuel etc. since most of the houses are joint type, a solar water heater system and a solar PV is proposed in this study as follows.

Solar PV and Solar water heater design of a modern house in khokana

Name of the owner: Manik maharjan

No. of family member – male=6 , female=4

Mode of electricity consumption

1. Lighting
2. Cooking
3. Other machineries like TV, radio etc.

Type of luminaire

1. Incandescent
2. CFL

Amount of water consumption per day = 400 Ltr. (Maximum)

Solar water heater design

Hot water requirement

• Energy gained = Energy Loss:

$$m_1C(T_c\text{-}T_m) = m_2C(T_h\text{-}T_m)$$

i.e. = Mass of water (kg) x Specific heat of water x Temperature diff. (K).

– Specific heat of water = 4.2kJ/kgK

– Assume: 1 kg water = 1 liter water

This family with 10 people has hot water requirement for bathing purpose.

• Assumption: – required water temp=30^0C

– Required water quantity = 40 liters per person.

– SWH can raise the water temp to 57^0C (Average maximum temperature raised in SWH collector in Kathmandu valley)

– Cold Water inlet temperature = 10^0C (water temperature normally does not fall below this temperature)

Now, we have by energy balance for each person:

– 40*C*(30-10) = m_2*C*(57-30)

– Then m_2 = 29.7 liter:

For other uses like hand washing, add 5 liter i.e. 34 liter. – Recommend: 34 liter * 10 person = 340 nearly equals to 400 liter hot water storage tank system

collector area		*reservoir size*
3.0 m²	**(2 panels)**	**150 l reservoir**
4.5 m²	**(3 panels)**	**250 l reservoir**
7.5 m²	**(5 panels)**	**400 l reservoir**
10.5 m²	**(7 panels)**	**600 l reservoir**

Solar PV Design

Particular	**Quantity**	**Power (Watt)**	**Daily operation (Hours)**
Electric lamp Incandescent	**5**	**40**	**4**
Electric lamp LED	**5**	**3**	**5**
Radio	**1**	**3**	**1**
Television LCD	**1**	**70**	**7**
Total		**116**	

Energy required for electric lamp

Energy consumption for operating each lamp is calculated by multiplying the power rating (Watt) of it by the time of operation in hour.

$E_L = P_L H_L N$ ……………………

where,

E_L = Energy consumption by the lamp (Watt-hours)

P_L = Power rating of the lamp (Watt)

H_L = Daily operation time of the lamp (hours)

N = Numbers of bulb

For example daily energy consumed by the 40 watt lamp in the table for operating it for 4 hours per day is $E_L = 40 \times 4 = 160$ Watt hours.

Similarly, energy consumed by all the lamps is calculated and the total daily energy consumed by all the lamps is given by summation of all the energy consumption

$E_{L\ Total} = E_{L1} + E_{L2} + E_{L3} + ...$

For the lamps given in the table, the total energy consumption for lighting lamps becomes,

$E_{L\ Total}$ = (40W x 4 hours * 5) + (5W x 3 hours*5)

= 800 Wh + 75 Wh = 875 Wh.

Energy required for radio

Energy consumption for operating radio is also calculated by using the expressions similar to the energy consumption for operating lamp.

$E_R = P_R H_R$

where,

E_R = Energy consumption by the radio (Watt-hours)

P_R = Power rating of the radio (Watt)

H_R = Daily operation time of the radio (hours)

Energy required for operating radio as per mentioned in the table is given by

E_R = 3 Watt x 1 hours = 3 Watt-hour

Energy required for television

Energy required for operating television is also calculated by using the expressions similar to the energy consumption for operating lamp.

E T = $P_T H_T$

where,

ET = Energy consumption by the television (Watt-hours)

PT = Power rating of the television (Watt)

HT = Daily operation time of the television (hours)

Energy required for operating television as per mentioned in the table is given by using the equation as following.

E T = 70Watt x 7 hours = 490 Watt-hour

Finally total daily energy requirement for operating all the devices of the solar home system users is calculated by

$E = E_{L\ Total} + E_R + E_T + \ldots..$

For the devices mentioned in the table the total daily energy requirement is given by,

E = 875 Wh + 3 Wh + 490 Wh =1368 Wh

Normally for Nepal, solar insolation is 4.5 kWh/m2/day (or Peak Sun of 4.5 hour).

After determining the Peak Sun, the current to be generated by the solar module is given by using the following equation.

$$I_M = \frac{E}{H_P \ x \ B_v}$$

where,

I_M = current generated by solar module (Ampere)

E = required total energy (Watt Hour)

H_P = peak sun (hours)

B_v = battery voltage (Volt)

Generally 12 V battery is used in the solar home system, so use B_V = 12V in the above equation.

$$Im = \frac{E}{Hp * Bv}$$

*= 1368/ 4.5*12*

= 25.33 Ampere

Selection of Battery

Selection of battery consists of determining the capacity of battery (Ampere-hour), Voltage of battery (Volt) and type of battery (Ordinary battery or Deep Cycle battery). Capacity of the battery is given by using the following expression,

$$C_B = \frac{E}{\eta_B \text{ x DOD x } B_V} x N_A$$

where,

CB = battery capacity (Ampere-hour or Ah)

E = daily energy consumption (Wh)

$?_B$ = battery charging efficiency (normally 0.8 to 0.95)

B_V = battery voltage (Volt)

NA = number of days to be operated without sunshine (Autonomy Days)

DOD = Depth of Discharge

Now considering NA = 3 day, ?B = 0.8 and DOD = 50% (or 0.5) and using the equation above for conditions given in table to determine the capacity of battery, we get

$$CB = \frac{1368 * 3}{0.8 * 0.5 * 12}$$

$$= 855 \text{ Ah}$$

The capacities of the battery available in the market are of standard sizes so during selection of the battery choose the available battery with the capacity that is just above the calculated capacity of the battery required. For example if calculated battery capacity is 855 Ah than select the standard 900 Ah battery. Since we have considered DOD = 50% and B_V = 12V the selected battery should be deep cycle battery.

Selection of Charge Controller

Charge controller should be able to with stand short circuit current (ISC) of the module and maximum battery to load current (IL max). Load current can be calculated by using following equation,

$$I_{L\,max} = \frac{P_T}{B_V}$$

where,

IL max = maximum battery to load current (Ampere)

BV = solar energy storing battery voltage (Volt)

PT = Total power (Watt)

To determine total power (PT) the power consumed by all the appliances like lamps, radio, TV has to be added. For the example in the table 7.1 the total power is calculated as

PT = 40 watt + 3 watt + 70 watt + 3 watt = 116 watt

and maximum load current is given by 116/12 = 9.6A

Generally the charge controller should be selected whose current bearing capacity should be two times that of IL max and ISC. The voltage rating of the charge controller should be same as the operating voltage of the solar home system.

An average home in the United States requires approximately 20 to 24 kWh of electricity every day. An array able to produce this much power must 4 kW or larger (based on 5 sun hours per day). So for 1.37kWh**, array able to produce must be round 275 W.**

PANEL NAME	WIDTH (IN.)	LENGTH (IN.)	WATTS	WATTS/SQ.
BP Solar BP175B	31	62	175	13.1
Evergreen ES-B-180	37	62	180	11.3
GE GEPV200	38	58	200	13.1
Kyocera KD-180GX-LP	39	52	180	12.8
Kyocera KD-205GX-LP	31	59	205	16.1
Sanyo HIP-195BA3	34	52	195	15.9
Sanyo HIP-200BA19	34	52	200	16.3
Sanyo HIT Power 205	34.6	51.9	205	16.4
Sharp ND-208U1F	39	65	208	11.8
Sharp NT-175UC1	32	62	175	12.7
Solarworld SW175	31	62	175	13.1

Suntech STP180S	31	62	180	13.5
AVERAGE:	**34**	**58**	**190**	**13.8**

So from these data, around 20 Square feet area is needed or two panel must be installed.

Solar PV and Solar water heater design of a modern house in khokana

Name of the owner: Madan krishna maharjan

No. of family member – male=1 , female=1

Mode of electricity consumption

4. Lighting
5. Cooking
6. Other machineries like TV, radio etc.

Type of luminaire

3. Incandescent
4. CFL

Mode of cooking

1. wood

Amount of water consumption per day = 100 Ltr. (Maximum)

Solar water heater design

Hot water requirement

• Energy gained = Energy Loss:

$m_1C(T_c\text{-}T_m) = m_2C(T_h\text{-}T_m)$

i.e. = Mass of water (kg) x Specific heat of water x Temperature diff. (K).

– Specific heat of water = 4.2kJ/kgK

– Assume: 1 kg water = 1 liter water

This family with 2 people has hot water requirement for bathing purpose.

• Assumption: – required water temp=30^0C

– Required water quantity = 50 liters per person.

– SWH can raise the water temp to 57^0C (Average maximum temperature raised in SWH collector in Kathmandu valley)

– Cold Water inlet temperature = 10^0C(water temperature normally does not fall below this temperature)

Now, we have by energy balance for each person:

– 50*C*(30-10) = m_2*C*(57-30)

– Then m_2 = 37.03 liter:

– Recommend: 37.03 liter * 2 person =nearly equals to 75 liter hot water storage tank system

SOLAR PV DESIGN

Since this house uses in-efficient bulbs so for solar design we recommend LED bulbs and solar PV only for lighting purpose.

Particular	Quantity	Power (Watt)	Daily operation (Hours)
Electric lamp LED	**5**	**5**	**5**
Total		**5**	

Energy required for electric lamp

Energy consumption for operating each lamp is calculated by multiplying the power rating (Watt) of it by the time of operation in hour.

$E_L = P_L H_L N$ ……………………

where,

E_L = Energy consumption by the lamp (Watt-hours)

P_L = Power rating of the lamp (Watt)

H_L = Daily operation time of the lamp (hours)

N = Numbers of bulb

Daily energy consumed by the 5 watt lamp in the table for operating it for 5 hours per day is = 5 x 5 = 25 Watt hours.

For the lamps given in the table, the total energy consumption for lighting lamps becomes,

E_L = (5W x 5 hours*5)

= 125 Wh

Normally for Nepal, solar insolation is 4.5 kWh/m2/day (or Peak Sun of 4.5 hour). After determining the Peak Sun, the current to be generated by the solar module is given by using the following equation.

$$I_M = \frac{E}{H_P \ x \ B_v}$$

where,

I_M = current generated by solar module (Ampere)

E = required total energy (Watt Hour)

H_P = peak sun (hours)

B_v = battery voltage (Volt)

Generally 12 V battery is used in the solar home system, so use B_V = 12V in the above equation.

$$I_m = \frac{E}{Hp * Bv}$$

*= 125/ 4.5*12*

= 2.314 Ampere

Selection of Battery

Selection of battery consists of determining the capacity of battery (Ampere-hour), Voltage of battery (Volt) and type of battery (Ordinary battery or Deep Cycle battery). Capacity of the battery is given by using the following expression,

$$C_B = \frac{E}{\eta_B \times DOD \times B_V} x N_A$$

where,

CB = battery capacity (Ampere-hour or Ah)

E = daily energy consumption (Wh)

$?_B$ = battery charging efficiency (normally 0.8 to 0.95)

B_V = battery voltage (Volt)

NA = number of days to be operated without sunshine (Autonomy Days)

DOD = Depth of Discharge

Now considering NA = 3 day, ?B = 0.8 and DOD = 50% (or 0.5) and using the equation above for conditions given in table to determine the capacity of battery, we get

$$CB = \frac{125 * 3}{0.8 * 0.5 * 12}$$

$$= 78.125 \text{ Ah}$$

The capacities of the battery available in the market are of standard sizes so during selection of the battery choose the available battery with the capacity that is just above the calculated capacity of the battery required. For example if calculated battery capacity is 78 Ah than select the standard 80 Ah battery. Since we have considered DOD = 50% and B_V = 12V the selected battery should be deep cycle battery.

Selection of Charge Controller

Charge controller should be able to with stand short circuit current (ISC) of the module and maximum battery to load current (IL max). Load current can be calculated by using following equation,

$$I_{L\,max} = \frac{P_T}{B_V}$$

where,

IL max = maximum battery to load current (Ampere)

BV = solar energy storing battery voltage (Volt)

PT = Total power (Watt)

To determine total power (PT) the power consumed by all the appliances like lamps, radio, TV has to be added. For the example in the table the total power is calculated as

PT = 5 watt

and maximum load current is given by 5/12 = .42A

Generally the charge controller should be selected whose current bearing capacity should be two times that of IL max and ISC. The voltage rating of the charge controller should be same as the operating voltage of the solar home system.

An average home in the United States requires approximately 20 to 24 kWh of electricity every day. An array able to produce this much power must 4 kW or larger (based on 5 sun hours per day). So for 125Wh**, array able to produce must be round 25 W.**

Land use planning approach

The peripheral development of Khokana and the land use changes taking place in haphazard manner should be regulated so that a compatible development to the traditional core can be achieved. In this regard, sustainable tourism development for conservation of traditional settlement should take land use planning approached as a major strategy. A special zone around the traditional settlement should be allocated as a transitional space between the traditional settlement and new developing area to minimize the effect and infringement of the development.

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- Creating awareness among local people about the importance of their heritage
- Active participation of community is utmost necessary for the smooth implementation of any project
- Mechanism of income generation should be worked out for the self-sustenance of cultural functions.
- As Khokana is still famous as a specialized settlement in oil production, traditional oil production should be revived. The revival of traditional method for oil extraction will not only provide economic base to the inhabitants but also help in development of tourism.
- To regulate land use compatible to traditional settlement, transitional zone should be development with low rise high density and mixed land use development.
- Proper bye law should be worked out at least to maintain the compatible street façade within the core area.
- Public or community space should be created for various activities like social gatherings, market space, and parking or just for open or green space.
- Due to the dense settlement with very little open space, the VDC lacks public sports and recreational space. Although there are four courtyards within the settlement, it is not appropriate for sports. Presently, youths are using school

premises and a public space around the Shilkali temple for such sports and recreational activities.

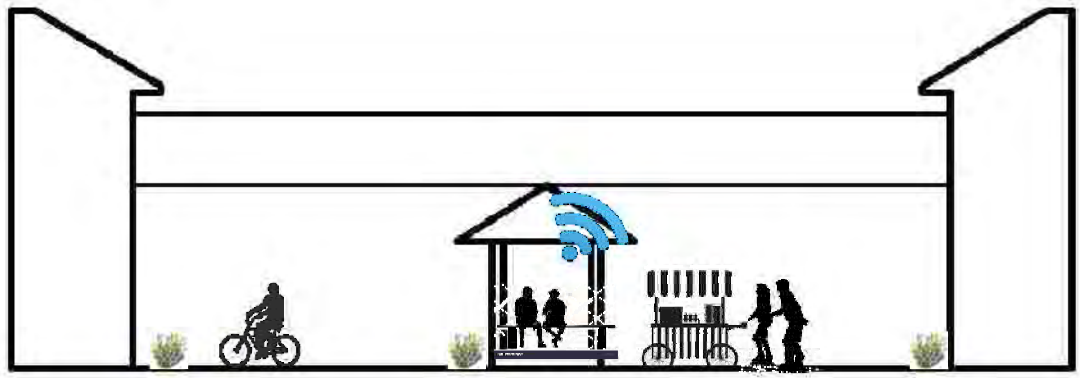

Fig: Feasible improved scenario of open spaces of Khokana

Fig: Feasible improved scenario of streets of Khokana

The overall ecological landscape of Kirtipur has even today not been severely affected by urbanization as in the case of other cities like Kathmandu and Patan. Most of the land use is still agricultural although employment pattern of Kirtipur is slowly shifting from agriculture to service and others. The agricultural land and the forest areas have been encroached; however not to a great extent. Much of this can be attributed to the fact that economic development has been very slow in Kirtipur and people are dependent on Kathmandu for employment opportunities.

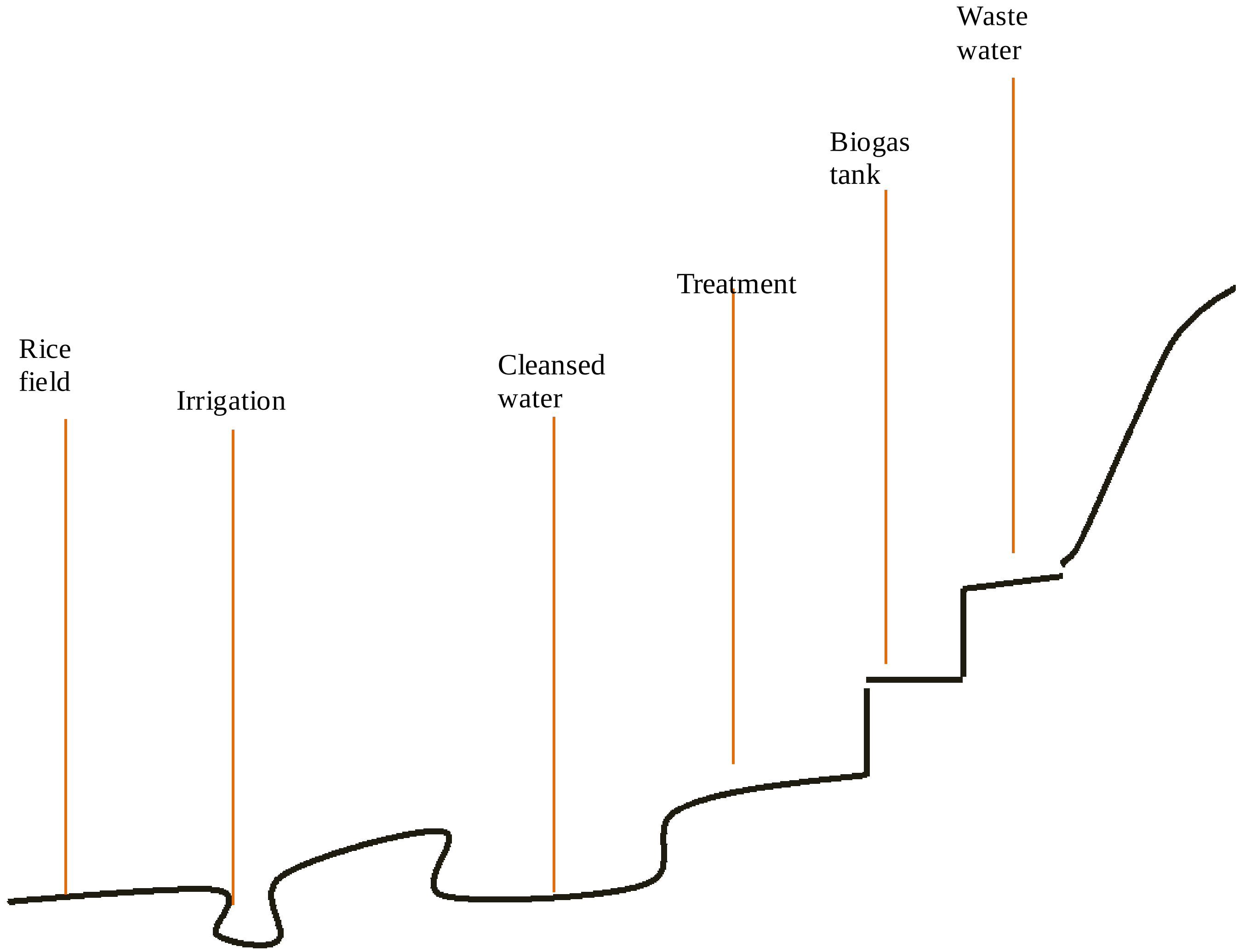

Fig: Feasible irrigation system for Khokana using treated water

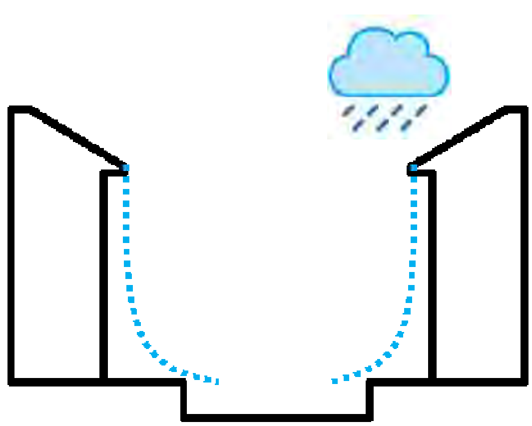

Fig: Feasible rainwater harvesting in the residential core area

CONCLUSION

The basic findings of the study i.e. the transformation have been related to changing environment of Khokana. The certain land use changes happening in core area and the peripheral development area are due to gradual emergence of residential development and market centers in Bhainsepati next to Khokana and trend of outward migrant from core to peripheral area due to breakup in family structure. The development in the surrounding of khokana in turn can be as an outgrowth of the process of urbanization of Lalitpur and the internal densification of the core area. However, local people have not been able to benefit from the change or development happening in and around Khokana. The higher land transaction near Sainbu and along the arterial road shows that the development pressure will sooner or later engulf Khokana, also. So if some planning and policy provision are not made immediately, the development pressure will soon affect the traditional set up of Khokana.

In summary, we can conclude that the urban transformation in Khokana have not been satisfactory as the economic condition has been substandard, the living condition is not good, overall physical infrastructures are in poor state, historic building and monuments are deteriorating, cultural heritage is in threat due to haphazard development in and around the settlement, rituals and cultural function are disappearing and traditional occupational base in agricultural and oil production are declining.

In this regard, tourism development in Khokana can be used as and effective to uplift the economic condition of the inhabitants as Khokaa is still able to retain traditional character and its rich cultural heritage. Thus, planning intervention in Khokana should be made immediately to preserve the image of Khokana and at the same time create development endeavors to plan Khokana with modern amenities and services. Conservation and development should complement each other and go hand in hand for the overall development of Khokana.

Some areas of Kirtipur still displays the traditional character however due to the changing lifestyle and use of modern construction technologies, the traditional identity of the traditional core is in the verge of deterioration. The ancient layout of open spaces and built up areas on the hilltop has however survived with little change in recent years.

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3. *Regulating The Burning and Disposal of Solid Wastes*. (n.d.). Retrieved from http://brightonvt.org/.
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5. Google Earth
6. www.wikipedia.org/khokana

A SEMINAR PRESENTATION

ON

THE SUSTAINABILITY ASPECTS OF

TRADITIONAL STRIP -KIRTIPUR

AND URBAN STRIP – KOHINOOR HOUSING

SUBMITTED TO:
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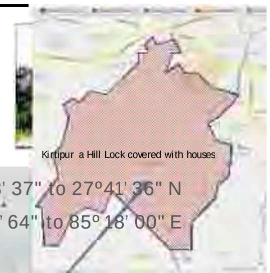
SUSHIL GYAWALI (072MSES466)

INTRODUCTION (Kirtipur)

- Traditional Ancient Settlements
- 5 km to the West of Kathmandu
- Total Area : 14.67 sq.km
- Geographical Location:



Kirtipur a Hill Lock covered with houses

27º 38' 37" to 27º41' 36" N

85º 14' 64" to 85º 18' 00" E

2

INTRODUCTION (Baafal)

- Modern Settlements
- Prime location of the City
- Geographical Location:

27° 41' 35" North

85° 16' 56" East.

Aerial view of Urban Strip (2 x 0.5 km)

Source : KU LUEVEN

3

OBJECTIVES

General Objectives

-To look at the Parameters of Sustainability from the perspective of Economic, Environmental And Socio-cultural Aspects of Kirtipur

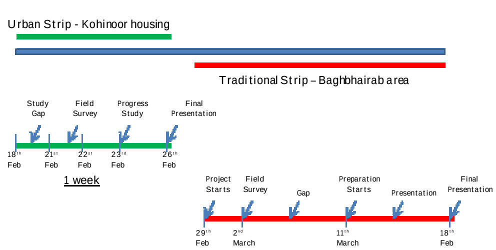
Specific Objectives

-To look at the following Sustainability parameters:

§ Sustainable Land use
§ Sustainable Transportation
§ Environmentally sound technologies in energy
§ Sustainable water and waste water system
§ Sustainable solid waste management
§ Sustainable Housing and Buildings
§ Economic Sustainability
§ Socio-cultural Sustainability
§ Socio Economic Aspects
§ Earthquake

4

TIME FRAME AND LIMITATION



- Observation, Map and Photos (Primary Data)
- Questionnaire Survey of only 24 respondents
- Literature Review (Secondary Data)

5

METHODOLOGY

§ EXPLORATORY, DESCRIPTIVE AND OBSERVATION
§ SELECTION OF THE STUDY AREA (GOOGLE EARTH)
§ MAP STUDY, DOCUMENT STUDY, LITERATURE REVIEW
§ FIELD VISIT
§PICTURES
§INTERACTION WITH THE LOCALS
TOOLS- QUESTIONNAIRE
§FREE HAND SKETCHES
§MEASUREMENT OF ROAD- PACING

6

QUESTIONNARE

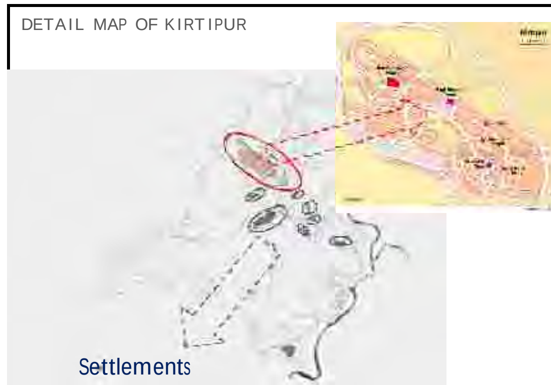
QUESTIONNARE FORMAT

QUESTIONNARE FORMAT

Sample of questionnaire (House no. 1)

Respondent: Housewife

DETAIL MAP OF KIRTIPUR



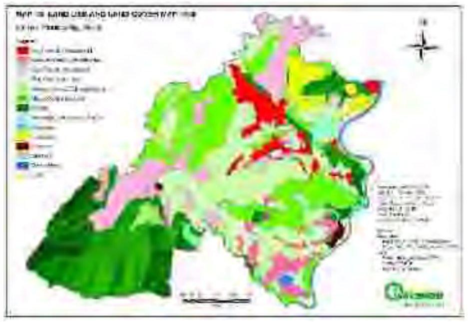
LAND USE

Land Use and land Cover Map of the year 1992, 1998, Google Earth map of the year 2005, 2015, Possible Future Expansion, Proposal For Sustainability Development

LAND USE MAP

Source : GIS for Municipal planning

LAND USE MAP



Source : GIS for Municipal planning

13

MAP OF 2005

Source : Google Earth

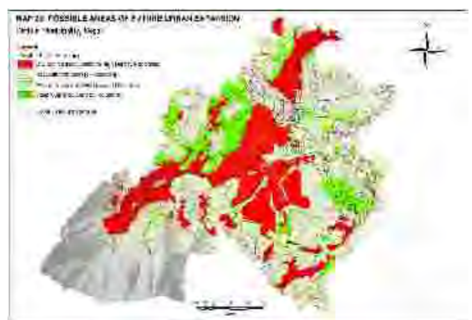
14

MAP OF 2015

Source : Google Earth

15

POSSIBLE AREAS OF FUTURE EXPANSION



Source : GIS for Municipal planning

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PROPOSAL FOR THE SUSTAINABLE DEVELOPMENT

17

TRANSPORTATION

Transportation Network, Road map, Road Width, Sustainability Issue

18

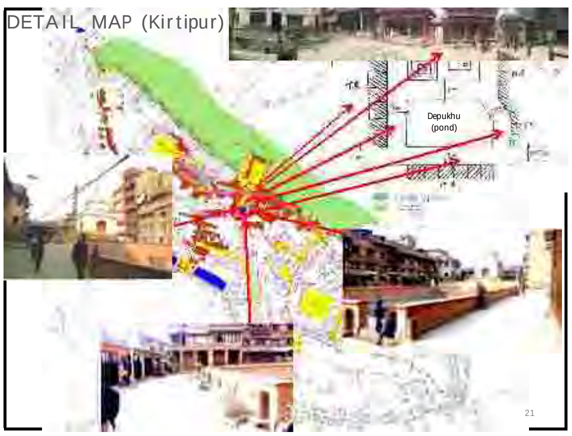
SUSTAINABLE TRANSPORTATION (Literature Review)

§ Shades in the streets
§ Reduce heat Island Effect
§ To Sequester the carbon
§ Re-charge water table
§ Reclaimstreets as inviting public space

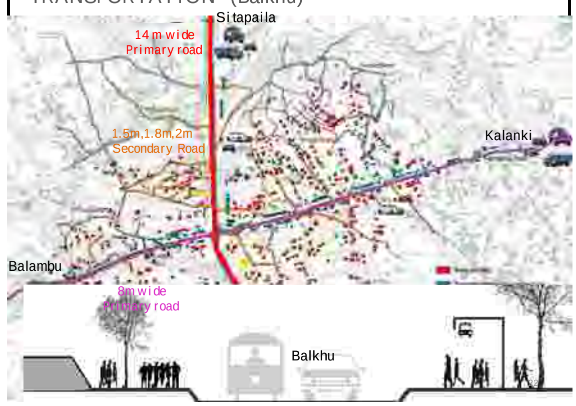
Sustainable Road (Literature)

TRANSPORTATION (Kirtipur)

DETAIL MAP (Kirtipur)



TRANSPORTATION (Balkhu)



SOCIO-CULTURAL ASPECT

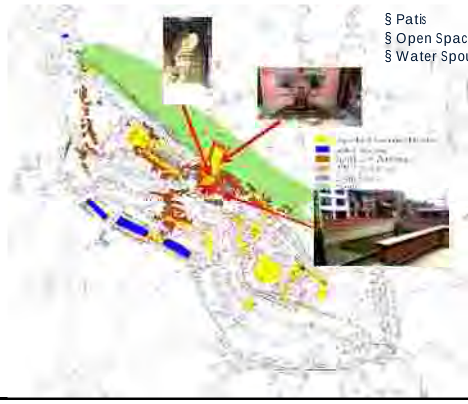
Cultural heritage (Temples), Patis, Open Spaces, Water Spouts, Cultural Route

SOCIO CULTURAL ASPECT

§ Cultural Heritage
§

SOCIO-CULTURAL ASPECT

§ Patis
§ Open Spaces
§ Water Spouts



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SOCIO-CULTURE (Cultural Route)

26

BUILT FORM

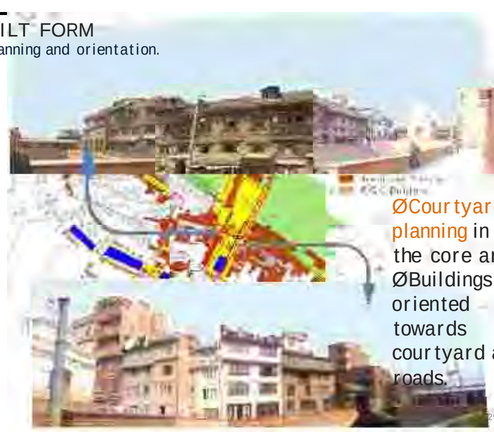
Planning, Typology, Height, Orientation

27

BUILT FORM
§ Settlements.

28

BUILT FORM
§ Planning and orientation.



ØCourtyard planning in the core area.
ØBuildings oriented towards courtyard and roads.

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BUILT FORM

§ Structure of the building.

Traditional buildings

Structure of traditional building made it appeared like modern RCC building

RCC buildings

§Thermal comfort.

ØMud mortar
ØThickness of wall about 2'
ØVolume of the house comparatively lower than modern buildings.

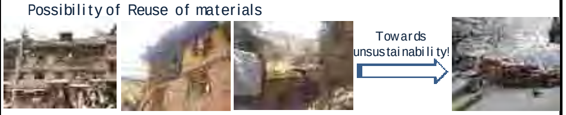
Traditional buildings

30

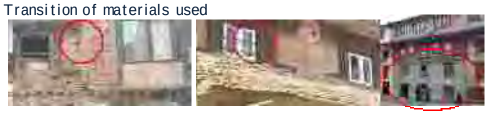
BUILT FORM

§ Materials.

Possibility of Reuse of materials



Transition of materials used



Reasons for transition:

ØRecyclable Traditional materials: Bricks with mud mortar and timber.

ØTransition taking place towards un-sustainability.

ØFactors: Cost, space, availability of materials, sense of modernity.

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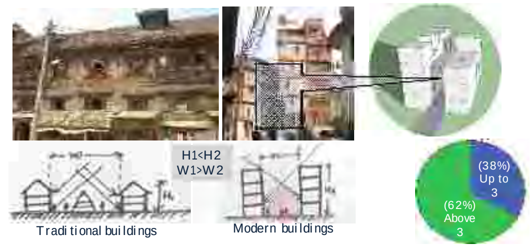
BUILT FORM

§ Height of the building.



§ Floor height increasing.

§ No. of storey also increasing.

§Ratio of height of the buildings and width of road is not appropriate.

§No proper sunlight.

§Hindrance to practices such as drying vegetables, making pickles etc.

§Diminishing cultural practices.

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BUILT FORM

§ Recommendations

ØSundried bricks could be used in internal walls.

ØTimber could be used with proper maintenance.

ØHeight and width ratio should be properly maintained to incorporate sunlight.

ØLaws regarding constructing houses should be implemented.

ØConstruction of traditional houses should be emphasized.

ØHeight and width ratio could be properly managed.

33

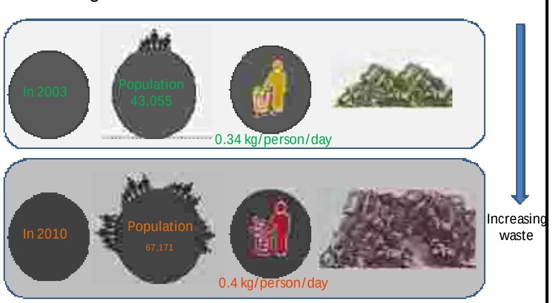
SOLID WASTE MANAGEMENT

Management cycle, Quantity, Pattern

34

SOLID WASTE MANAGEMENT

Ø Increasing amount of waste



35

Source: (Sthapit, 2010), (Tuladhar, 2003)

SOLID WASTE MANAGEMENT

ØChange in consumption pattern and lifestyles.

Past

Present

Short term beneficial as it is easier but hazardous in the long run.

ØModernization is taking place.

ØEconomic development occurring parallel to it.

ØLifestyle of people changing.

ØAvailability and consumption of processed foods.

ØPlastic wrapped used prominently.

ØProduction requires harmful preservatives.

ØGeneration of plastic waste polluting environment.

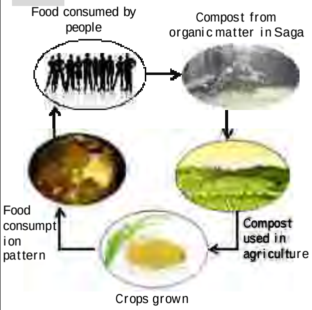
ØHealth of people also challenged.

36

SOLID WASTE MANAGEMENT

ØPast and Present waste management cycle

Past



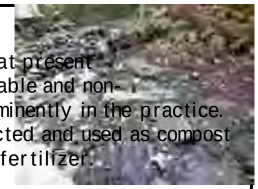
Closed loop
of solid waste management.

ØPeople consumed what they grew in farms.
ØProduction of >95% of organic waste.
ØOrganic matter converted into Compost in Saga.
ØCompost made is used in the farms as soil fertilizer and enhance productivity.

Past: Sustainable cycle of solid waste

37

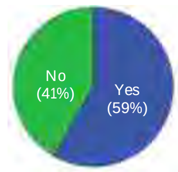
SOLID WASTE MANAGEMENT



ØPractice of Saga is not seen at present.
ØBut, separation of biodegradable and non-biodegradable is still seen prominently in the practice.
ØThe biodegradable was collected and used as compost in the kitchen garden as a soil fertilizer.

Reasons for diminished practice of Saga:
ØChange in occupation.
ØDiversion from agriculture based economy to different jobs such as driver, computer engineers, shop retailer etc.

We invest our effort when we need it!



Separation of biodegradable and non-biodegradable wastes

SOLID WASTE MANAGEMENT

ØPast and Present waste management cycle

Present

Open loop
of solid waste management.

Reasons:
ØTrend of consuming processed foods rising
ØThey are packed in plastics.
ØProduction of organic as well as inorganic waste.
ØPlastics are non-biodegradable.
ØFinal disposal in the rivers.

Present: Unsustainable cycle of solid waste

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SOLID WASTE MANAGEMENT (Baafal)

Unmanaged Solid waste management

•Dumping on the open spaces adjacent to the residences

40

SOLID WASTE MANAGEMENT

ØRecommendations

ØCommunity composting could be promoted.
ØEnd users for composting should be defined for enhancing economy.
ØGeneration of solid waste should be minimum by changing the practice.

41

SOCIO-ECONOMIC ASPECT

Mix use of buildings, Women Empowerment

42

SOCIO-ECONOMIC ASPECT

§Functional use of the buildings.

Cloth shop | Retail shop | Carpet weaving factory | Retail shops

Traditional buildings | Modern buildings

§Mixed use of buildings were seen even in traditional buildings.
§Emphasizes on income generating activities.
§Promotes Local economy.
§Women getting involved thus enhances women empowerment.
§Towards, Economic sustainability.

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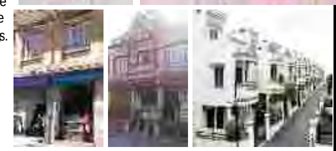
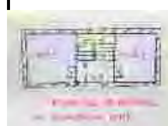
SOCIO-ECONOMIC ASPECT (Baafal)

•Functional use of the buildings

•Commercial Zone •Mixed Zone •Residential Zone

•More than one function in one single buildings.
•One staircase serving two units.





•Shops on ground floor and residence on upper floors.

•Only residences in all floors.

44

ENVIRONMENTAL ASPECT

Clean Environment

45

ENVIRONMENTAL ASPECT

§Clean Environment

46

ENVIRONMENTAL ASPECT (in Baafal)

Polluted Environment

ØScenario is at worst state
ØWastes littered everywhere
ØNo management of waste

ØRecommendations

ØPublic awareness program could be initiated to produce less waste.
ØAlternative use of plastic should be taken into consideration.
ØPlastic waste could be used as fuel for cement kilns or a raw material in building the Bitumen road.

47

ECOLOGICAL BIODIVERSITY

Green space, Forest

48

ECOLOGICAL BIODIVERSITY

Prevalence of agricultural land

Prevalence of forest area

- Urbanized is taking place.
- But, still there is prevalence of agricultural land and forest area.

Ecological Biodiversity

49

ECOLOGICAL BIODIVERSITY (in Baafal)

Very less green space left

- Urbanized heavily
Many concrete buildings coming up
Depleting the green area
- Very less open space left

Less Ecological Biodiversity

Ø Recommendations

Ø Laws regarding conservation of green land should be enforced.

50

WATER MANAGEMENT

Traditional and Modern Water Sources, Water Supply, Cycle and Recharge

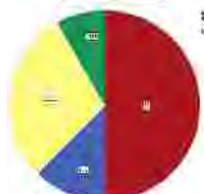
51

WATER SOURCES: From PAST To PRESENT

TRADITIC

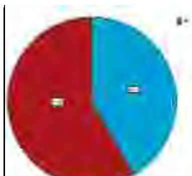
PRESE

Traditional
Present

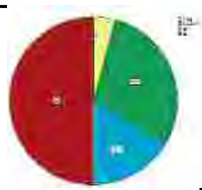


Source: Field survey

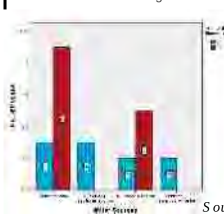
Behavior Change

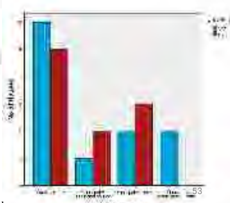


Rainwater Harvesting



Use of Greywater





Source: Field survey

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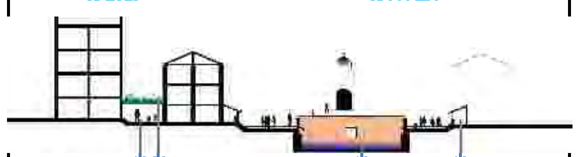
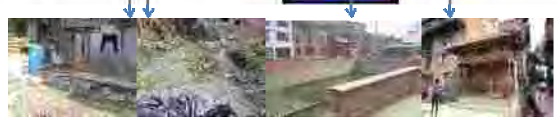
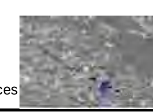
Ground Water RECHARGE: NATURAL WATER CYCLE

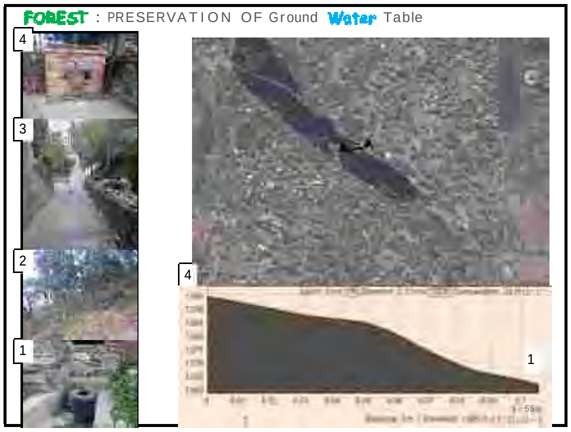


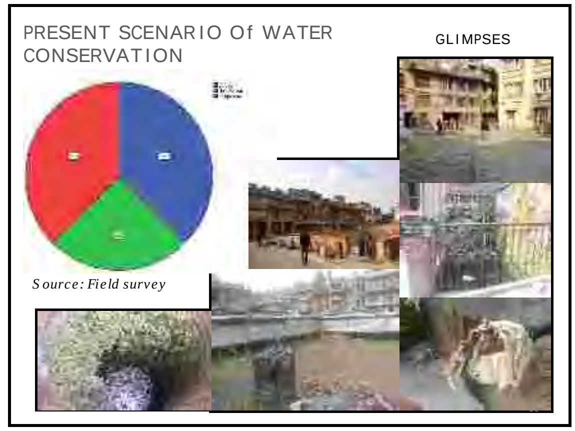


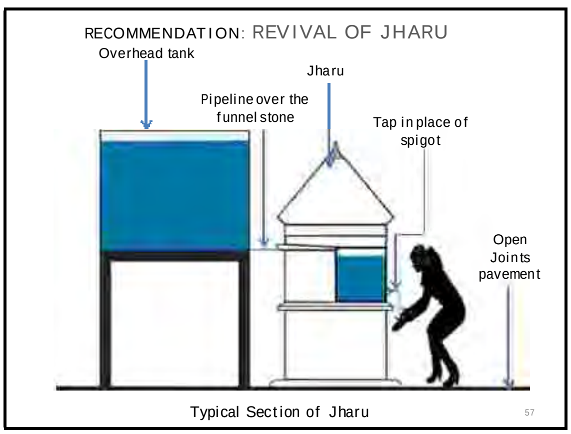
Typcial section at Dev Pukhu

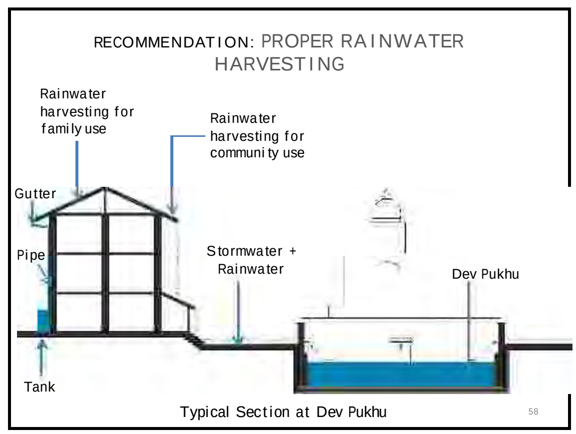
Urban ecosystem
Water cycle
Ground water recharge
Kitchen garden, paved courtyards, ponds, streets, open spaces

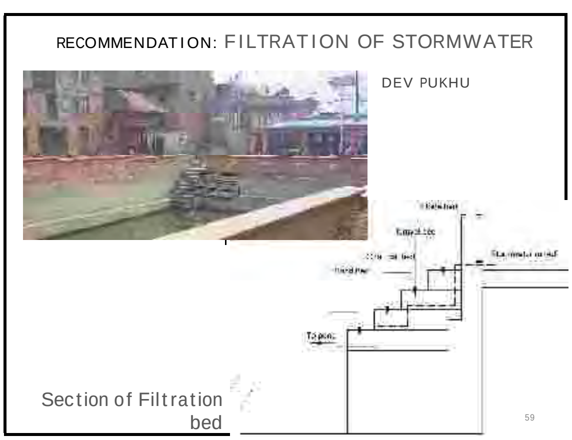



FOREST : PRESERVATION OF Ground Water Table
4
3
2
1
4
1

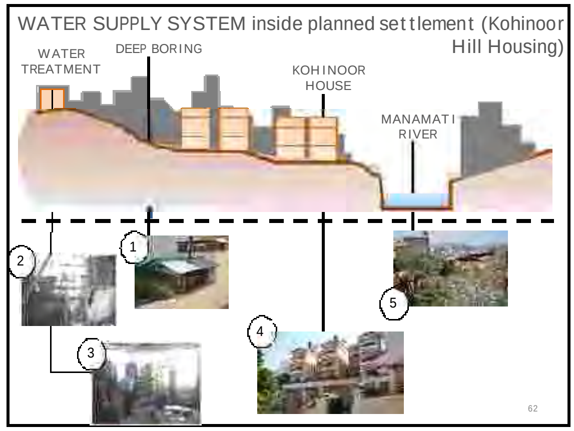

PRESENT SCENARIO Of WATER CONSERVATION
GLIMPSES
Source: Field survey

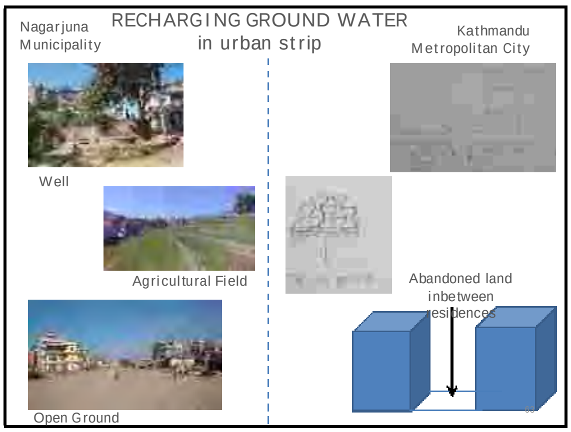

RECOMMENDATION: REVIVAL OF JHARU
Overhead tank
Jharu
Pipeline over the funnel stone
Tap in place of spigot
Open Joints pavement
Typical Section of Jharu
57


RECOMMENDATION: PROPER RAINWATER HARVESTING
Rainwater harvesting for family use
Rainwater harvesting for community use
Gutter
Pipe
Stormwater + Rainwater
Dev Pukhu
Tank
Typical Section at Dev Pukhu
58


RECOMMENDATION: FILTRATION OF STORMWATER
DEV PUKHU
Section of Filtration bed
59


RECOMMENDATION: Revitalization Of Courtyards & Micro Retention Pond
2
3
4
5
Dev Pukhu
Micro Retention pond
1
5
4
1
3
2
Central Chowk
60

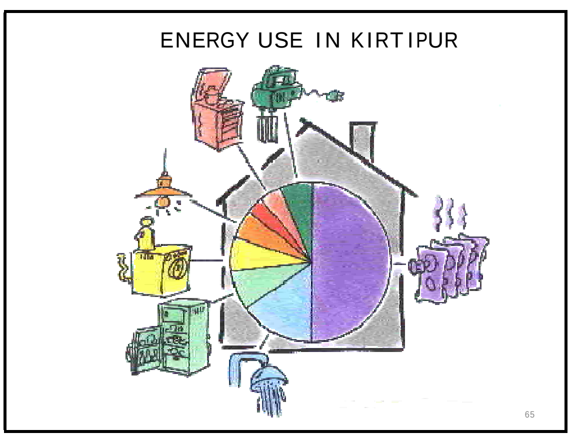




ENERGY

Solar Energy, Statistical data's through Pie chart, Solar Photo-Voltaic Panel

64



SOLAR ENERGY IN KIRTIPUR

- Less use of solar PV Panel- very low capacity (10-50 watt)
- Only few household have solar thermal water heater
- Mostly based in electricity for heating and cooling

66

SOLAR ENERGY IN KIRTIPUR

Solar street lights in public spaces

67

- High demand of electricity
- Necessity of developing sustainable and appropriate alternative

68

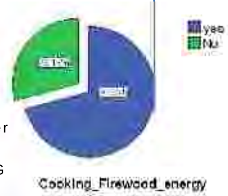
Most of traditional houses Have mud cooking stove

High possibility of Replacing with Improved Cooking Stoves

All household use LPG

Almost all have extra cylinder

Biomass fuel replaced by LPG



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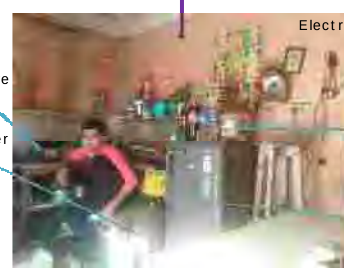
Changing trend in energy use

Gas stove

LPG cylinder



Electric water heater

Rice cooker

Refrigerator

ENERGY EFFICIENCY?

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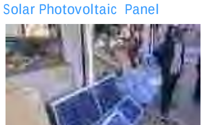
Solar Energy in Bafal:

Solar Photovoltaic Panel



Unplanned Settlement of Bafal

Solar Water Heater

Flat type

Vaccum tube type

Planned Settlement of Kohinoor Housing

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EARTHQUAKE

Traditional Structures that stood intact during earthquake, Factors contributing to the intactness of structure during earthquake, Vulnerable Building Practice, Awareness Programs

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Traditional Structures that stood intact during earthquake

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Factors contributing to the intactness of structure during earthquake.

- Symmetrical
- Double Framing of Openings:
  - Two complete frames of timber (tied to each other) around the openings to strengthen it against lateral force.
  - Location of openings have been carefully controlled keeping all windows at least 3 feet away from corners so as not to weaken them.
- Monolithic Character of The Structure Using Horizontal Ring Beam:
  - earthquake force is resisted by the building as complete unit rather than by individual parts.
- Roof Held Tightly to The Wall:
- Use of "Chokus" or Wedges:
  - providing structural integrity between floor joists and wall
  - Absorbing some portion of earthquake energy thus reducing the earthquake effect on the building.
- Supporting geology:

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Vulnerable building practice

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Awareness Programs

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CONCLUSION

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Study focused on analyzing sustainability factors in kirtipur.

- Based mainly on observations, household survey of only 24 houses, cannot be generalized to whole kirtipur but may be more representative to Bagbhairav area.
- Haphazard sprawl, Changing land use pattern, increasing built up area, decreasing agricultural and forest area.
- Changing towards unsustainable practice of use of building materials and haphazard structural orientation.
- Challenged Solid waste management, no use of saga and nauga, changing to open loops from closed of SW mgmt.
- Decreasing ground water resources, increased paved surface, dependency on centralized supply.
- Heavily dependent on fossils fuel energy, but increasing trend of solar energy, street lights using solar.
- Traditional structures not much damaged as predicted during earthquake, but changing to vulnerable building practice.

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RECOMMENDATION

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- Compact settlement should be emphasized thereby preserving forest and agricultural areas.
- Use of locally available buildings materials to be promoted, vulnerable building practice to be nullified.
- separation of SW, Home composting , closed loops of solid waste management to be promoted.
- GW recharge to be enhanced, rain water harvesting to be promoted, dependency on centralized supply to be minimized, Revival of traditional water resources ,
- Dependency on fossils fuel energy to be replaced by RE most feasible solar.
- Traditional structures can still be built seismic resistant ,thereby conserving culture, minimizing energy and GHG.

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THANK YOU

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TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

MSC IN ENERGY FOR SUSTAINABLE SOCIAL DEVELOPMENT

CENTRAL CAMPUS

A

report on

Study of Sustainability Elements in Kirtipur and Baafal

(Core Course 2)

Energy in Sustainable Urban and Rural Planning

(Credit 4)

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Contents

ABSTRACT

This report presents major aspects of sustainability, and discusses an approach to implement sustainable practices in urban planning and development in traditional areas of Kirtipur. Sustainability is now considered one of the key objectives in urban planning and creating eco-city. However, due to inappropriate planning, weak institutions, limitation of resources, inefficient energy use, inappropriate land use and poor implementation of policies, the aspects of environmental, socio-cultural, economic and energy sustainability has been shadowed. This report has focused in developing energy efficient solutions in order to conduct knowledge-driven sustainable social development and operation in the traditional zone of kirtipur.It has also dig on sustainability parameters such as land use, transportation, water and waste management, housing and passive design in kirtipur and a general comparitive analysis with urban settlement in Bafal is presented. Here the building material and techniques are analysed and the necessity of safe and sustainable construction providing comfort to the occupants is highlighted. This report has tried to reflect the development pattern in the traditional zone of kirtipur and analyze its present and future impacts.

1. Introduction:

Figure 1 Kirtipur, a Hillock covered with houses

Kirtipur is one of the traditional ancient settlements of Kathmandu valley which is 5 km to the south west of Kathmandu valley. It is also considered to be one of the satellite towns in the period of King Shiva Dev III (1099-1126 AD) with the total area of 14.76 sq.km and the total population of 65,032 according to the census 2011. It is located at 27º 38’ 37" to 27º41’ 36" N and 85º 14’ 64" to 85º 18’ 00" E and has total 19 wards in which only five wards i.e 2,3,5,9 and 18 are urban in character and the rest are still rural, its population still depending on agriculture for livelihood. It is bordered by the Bagmati river to the east, Machhengaun Village Development Committee (VDC) to the west, Kathmandu Metropolitan City (KMC) to the north, and Chalnakhel VDC to the south.

Kirtipur was established in the twelfth century as an outpost of Patan. It later became an independent kingdom for a short period. The town was built initially within a wall surrounded strategically by dense vegetation and then open ground as outer rings. Until 1950, the settlement was confined within the outer wall built during the Malla period (1168–1768 A.D.) (Manandhar and Shrestha 1990). Kirtipur was identified as a ‘town’ or urban locality in the 1952/54 and 1961 censuses of Nepal. It was declassified as a town in the 1971 census when the criteria for designating urban localities were changed The ancient layout of open and built-up areas on the hilltop has survived with little change in recent years, most expansion has been concentrated at the southern base of the hill.The establishment in Kirtipur of the Tribhuvan University campus, and the proximity of the municipality to the Ring Road, has made the area attractive as residential land for the people of Kathmandu. This has brought about significant changes in land-use patterns and the occupational structure of the municipality in recent years. (Shrestha B., 2003)

2. Brief Historical Background:

The history of the village goes back to the 12th century when it was an outpost of the Patan but later became a separate kingdom This was the site of an inspirational peaceful demonstration of the people in the 2006 mass uprising that overthrew the powers of the king. It is considered to be an anti-monarchy city due to its bitter history against the Shah dynasty whose modern founder conquered the city insultingly, which was followed by negligence of the administration and development by subsequent rulers. (Kirtipur-nepal.blogspot.com, 2016)

According to the History the ancient city of Kirtiopur was founded by Shiva Dev Between 1099 AD and 1126 AD and during the reign of the Malla kingdom in the 15th century, the city was developed for human settlement. Kirtipur’s Fortress was considered impregnable. The Gorkha

King Prithvi Narayan Shah laid siege to it three times before 1768 A.D. Finally, taking the town and then, it is said, only after it had been betrayed. Even today the weapons from those former battles are mounted at the roof of Baghbhairab Temple. He exacted terrible revenge for heavy Gurkha losses – his brother was among those killed by cutting off the nose and lips of every man and boy over the age of 12. Only wind- instrument players were spared and they were required to celebrate his triumph. The line of the old town wall, pierced by 12 gates, is still clearly visible. Most of the townspeople were weavers and farmers, the lower castes living outside the wall. (Bibek, 2016)

3. Objective

3.1. General Objectives:

- To look at the Parameters of Sustainability from the perspective of Economic, Environmental And Socio-cultural Aspects of Kirtipur

3.2. Specific Objectives:

- To look at the following Sustainability parameters:

§ Sustainable Land use
§ Sustainable Transportation
§ Environmentally sound technologies in energy and industry
§ Sustainable water and waste water system
§ Sustainable solid waste management
§ Sustainable Housing and Buildings
§ Economic Sustainability
§ Socio-cultural Sustainability

4. Methodology:

This Research is an Exploratory, Descriptive and base on the observation. There was limitation regarding time so maximum research was through our observation along with the photographs, free hand sketches, literature review, study of Google maps and other documents through the internet access and journals. In the case of the modern settlement i,e in the Baafal area, we went to the field with the Belgium students for assisting their projects for the two days. During this phase we roamed with them and took few pictures and few sketches. Only few questions were asked to the residents about the land use, electricity and other aspects but the questionnaire were not prepared. In general we searched the sustainability aspects in the modern settlement which became difficult to find out as no such traditional aspects were there. After two days intensive field work, we prepared presentation with the students of Belgium and presented in front of our teachers, professors of the Belgium students and others.

After the observation in the modern settlement, we were given task to observe the sustainability aspects in the case of traditional settlement. So, we took Kirtipur as our area of study. For this study we had an experience from the previous field work i.e Baafal area, so before visiting the site we prepared the questionnaire and surveyed 24 respondents. The sketches were made on the site and the photo graphs were taken like in the case of Baafal. Various sustainable aspects are found and noted unlike in the case of Baafal.

5. Land use:

For the purpose of orderly development and to reduce conflicts between urban and environmental usage, land use regulations are exclusively dedicated to land use, building types and structures.
Two types of Land Use Zones shall be defined as:

Non Built-up Zones in principal are to be reserved for unaffected nature; any usage is restricted as pre-scribed. Developments and structures are limited according Chapter 5. Control of Land Use for building or other Purposes.
In **Built-up Zones,** usages, developments, and structures are permitted as prescribed. Land shall only be developed and used in accordance with the permitted use(s) prescribed for each Built-up Zone in the fol-lowing sections. If exceptional permissible uses are intended, specific reasons have to be presented.

4.1. Non Built-up Zones

4.1.1 Forest Zones (F)

Forest Zones represent woodland, bush lands, and Zones without any vegetation.

4.1.2 Agricultural Zones (A)

Agricultural Zones are designated only for agricultural purposes, cattle breeding, fishing, cash crops and horticulture.

4.1.3 Green Spaces (G)

Green Spaces represent public and private parks, recreation Zones, botanical and zoological gardens, sports grounds, playgrounds, cemeteries, bathing areas and green open spaces

4.1.4 Water Bodies (W)

Water Bodies represent lakes, ponds, streams, canals, rivers, flood areas and spaces to be kept free in the interest of flood control.

4.1.5 Public Utility Use Spaces and Easements (U)

Public Utility Use Spaces and Easements are designated for waste and sewage disposal, for tipping and for drains, water mains, sewers and cables.

4.1.6 Conservation Zones (Cz)

Conservation Zones cover non built-up Zones like water bodies and their banks, green spaces, forests and public utility use spaces which are necessary for conservation from the environmental point of view. No other activities accept conservation, maintenance and recreation shall be allowed. Conserva-tion Zones within the boundary of Kirtipur Municipality are: the zone around the spring sources in Dudh Pokhari and Shim in Ward No. 7, the Manjushree Cave in Ward No. 14, Taudaha in Ward No. 15 (please see also annex) and the riverbank of the Bagmati River. The Conservation zones Dudh Pokhari and Shim as well as the Zone around Manjushree Cave may be developed as recreation zones. For these zones a Local Area Environment Conservation Plan may be prepared. (Municipality, 2008)

Following are the Land Use and Land Cover maps in the year 1992 and 1998 and Land Use and Land Cover Change map.

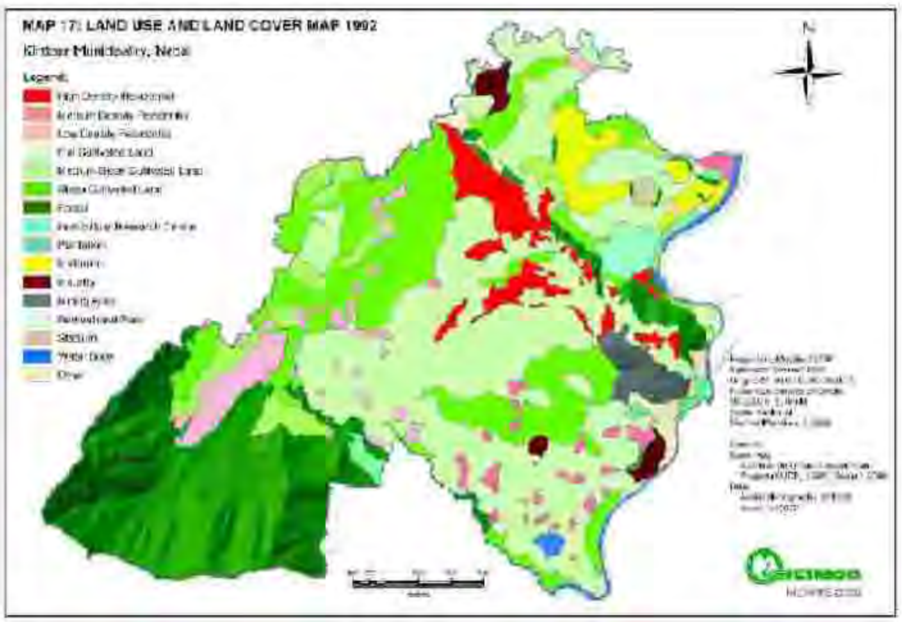


Figure 2: Land Use & Land cover Map 1992 (Source: GIS for Municipal Planning)

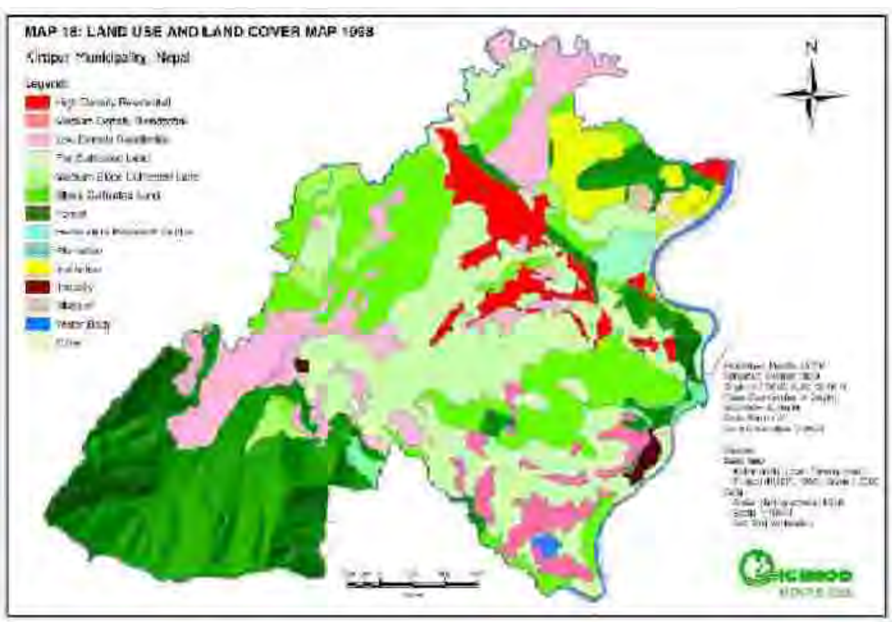


Figure 3: Land Use & Land cover Map 1998 (GIS for Municpal Planning)

4.2. Future Expansion:

While looking in the google map since 1992, it is found that the Urban growth has been continuously increasing. The flat and the steep agricultural land has been converted into the Residences. The low density residential areas has been transformed into the middle density residential areas and the middle density residential areas has been transformed into the high density residential areas. The following map in the various years are shown below:

Figure 4: Google map, 2005

Source : Google Earth

Figure 5: Google map of Kirtipur, 2015

From the Maps above, it is clear that there is a continuous Urban growth and the vegetative land areas have been converted into the Built form. So, the projected future expansion can be shown from the following map:

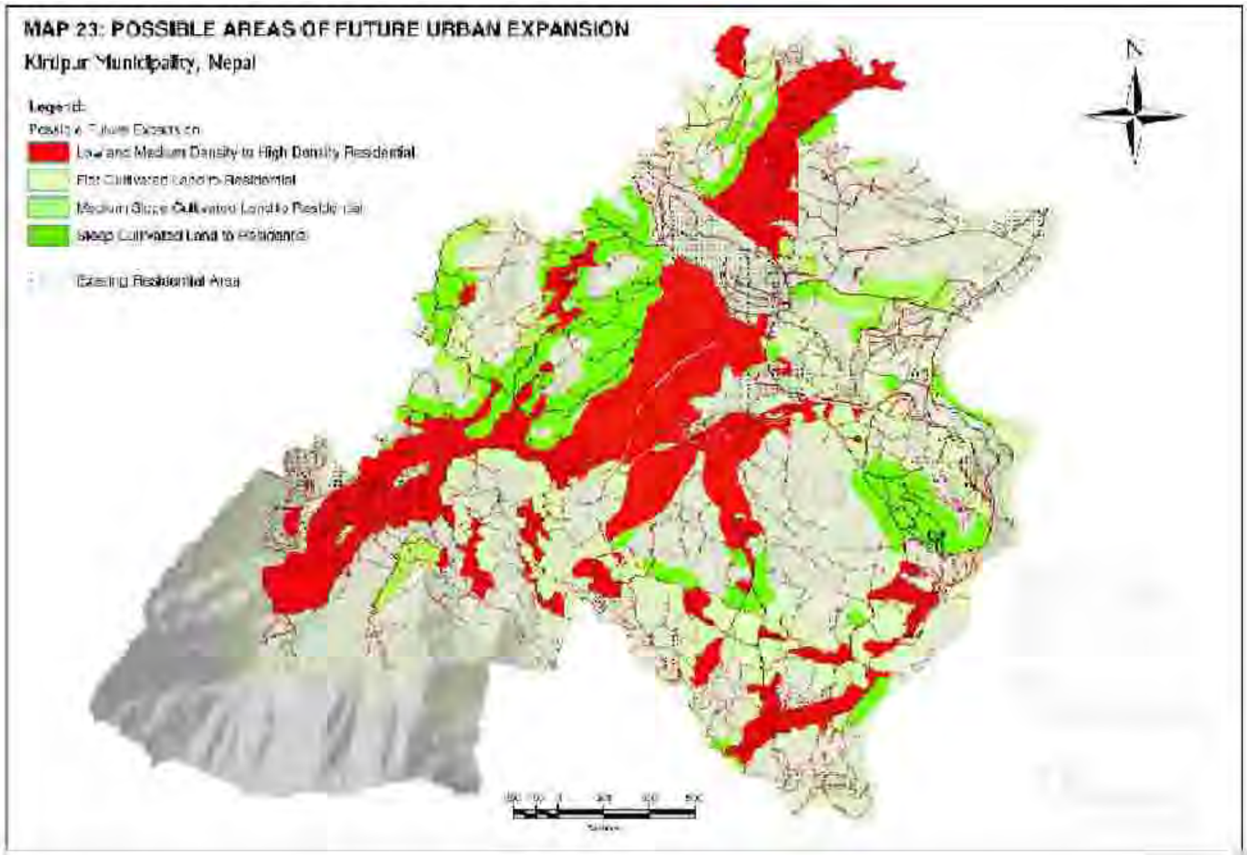


Figure 6: Possible future Urban Expansion

6. Socio- culture Sustainability:

According to the journal “Urban Social Sustainability Contributing Factors in Kuala Lumpur Streets” published on the Asian Conference on Environment- Behaviour Studies, Tehran , India, there are nine factors determining the social sustainability. They are shown in the diagram.

Figure 7: Significant factors affecting social sustainability of Urban places

6.1. Jatra’s of Kirtipur:

Kirtipur is rich in culture and traditions. As it is dominated by newars , their main festivals are jatras like Bagh Bhairab jatra, Indra jatra, Ganesh jatra, Krishna jatra and many other jatras.

6.1.1. Bagh Bhairab jatra:

Baghbhairab Jatra, a festival of Kirtipur locals who worship their most revered god Baghbhairab during the festival, the festival is marked on the occasion of Singha Sakranti (Bhadra 1). Local residents worship the god and make round of the Kirtipur area by organising a palanquin procession and playing different musical instruments.

Myth has that one is blessed with success and good health if he/she makes round of the Baghbhairab for 108 times on this day, according to a member of the festival management committee Birendra Shakya.

Figure 8:Baghbhairab temple

6.1.2. Gai jatra:

The festival of "Gai Jatra", the procession of cows, is generally celebrated in the Nepalese month of Bhadra (August-September). The festival of cows is one of the most popular festivals of Nepal. The whole complex of Gai Jatra festival has its roots in the ancient age when people feared and worshipped Yamaraj,"the god of death". However, the ironical sessions synonymous with the Gai Jatra festival came into tradition in the medieval period of Nepal during the reign of Malla Kings. Hence, the present form of Gai Jatra is a happy blending of antiquity and medievalism.

According to the traditions since times immemorial, every family who has lost one relative during the past year must participate in a procession through the streets of Kathmandu leading a cow. If a cow is unavailable then a young boy dressed as a cow is considered a fair substitute. In Hinduism, a cow is regarded as the most venerated among all the domestic animals. It is believed that the cow, revered as a holy animal by Hindus, will help the deceased relative's journey to heaven.

Figure 9: Gaijatra

Figure 10: Sapras of Gaijatra

In terms of historical evidences, once when King Pratap Malla lost his son, his wife, the queen remained dumbstruck. The king was very sad to see the condition of his beloved queen. The king, in spite of his several efforts, could not lessen the grief of his wife. By all means he wanted to see little smile on the lips of his sweetheart. He announced that someone who ever made the queen laugh would be rewarded adequately. (Kirtipur-nepal.blogspot.com, 2016)

7. Sustainability in transportation:

Transportation is also a subject of equal importance in contributing to the sustainable development. Transportation sector is significantly contributing towards the energy consumption and GHG emissions. Transportation accounts for about 19% of global energy use and 23% of energy related CO2 emissions and these shares is obviously to rise in the near future i.e. 50% by 2030 and more than 80% by 2050. (IEA, 2009) . So to minimize this frightening energy consumption and GHG emissions by transportation sector in future, it is must to think seriously from today. The transportation sector worldwide is heavily dependent on the fossils fuel thereby dominantly contributing on the GHG emissions. So the first step to be taken to reduce the energy consumption and GHG emissions through the transportation would be to shift towards the transportation system using the clean energy.

Sustainability in highways should be addressed with the understanding that highways are one part of transportation infrastructure, and transportation is one aspect of meeting human needs. In addition to addressing environmental and natural resource needs, the development of a sustainable highway should focus on access (not just mobility), moving people and goods (not just vehicles), and providing people with transportation choices, such as safe and comfortable routes for walking, cycling, and transit.

Sustainable transportation may be described or defined in many ways that broadly address environmental, social and economic impacts, safety, affordability, and accessibility of transportation services. Transportation agencies address sustainability through a wide range of initiatives, such as ITS, Livability, Smart Growth, Complete Streets, recycling, Planning and Environment Linkages, Everyday Counts and addressing requirements of the National Environmental Policy Act (NEPA).

Transportation planning processes that incorporate these values and integrate the elements of sustainability should be the foundation from which to implement sustainability decisions as a project moves forward. Measures of project success include a wide range of indicators, such as travel performance, gains achieved through material selection, and construction methods. (Transportation)

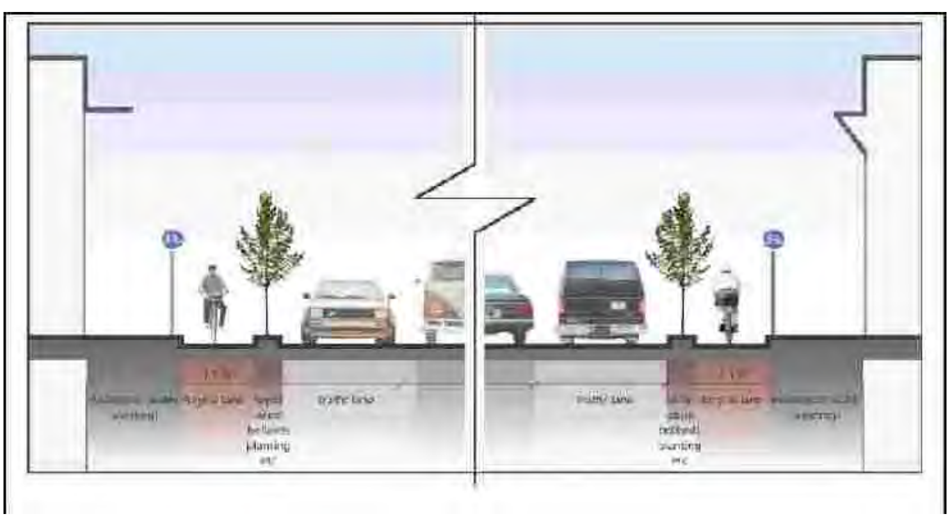


Figure 11: Sustainable Road with Physical Separation

For a road rating system to work effectively, the grading categories will have to be well defined, understandable to the public, and be irrefutably beneficial in terms of sustainability. Martina Soderfund, whose thesis paper sparked the *Greenroads* project, suggests six categories for a proposed rating system:

7.1. Sustainable Alignment

For most roads, cost of construction is the highest priority determinate of path. However, including this category in the consideration of sustainability ratings would add additional points for roads that avoided certain habitat types, such as wetlands, forests, farmlands, or other ecologically sensitive areas.

7.2.Materials and Resources

Asphalt, gravel, and tar have a high environmental footprint due to extraction, transportation, and use. The materials and resources category would reward projects that made efforts to reduce these impacts.

7.3.Stormwater Management

Seldom recognized by the general public, the continually increasing percentage of impervious land cover has negative implications for stormwater runoff and management. Promoting stormwater quality and quantity control through this category increases awareness of road impact and encourages the use of pervious surfaces.

7.4.Energy and Environmental Control

This category addresses some of the more subtle and inherent effects of typical roadway design. It evaluates the quality of design, while considering effects on light pollution, the heat island effect, quieter pavements, eco-viaducts (wildlife and fauna crossings), visual quality, and pedestrian/bicyclist access.

7.5.Construction Activities

The temporary activities of the roadway construction are a major source of pollution, waste, energy use, and health issues. Major concerns of this section can be categorized as: site disturbance, waste materials generation, noise pollution, emissions & energy usage, and the health of workers.

7.6.Innovation and Design

The credit definition of the last section is awarded for additional performance above the requirements set in the previous sections. Consider it extra credit or bonus points for exceptional performance in a particular category.

Regardless of how high of a priority sustainability is becoming, we will be using roads for years to come. Instead of throwing up our hands in defeat at the environmental impact they produce, forward thinkers encourage attempts to mitigate impacts. Although a rating system would be flawed, just as LEED is, any attempt to improve road sustainability would be better than nothing. (McClendon, 2012)

8. Solid Waste Management

Globally people deal with global warming, changing climate and many environmental issues. The lifestyles of people are changing with the cities urbanizing and the rise in the people's economic level. With the change in the lifestyle comes the change in composition and quantity of wastes as well. More areas of cities are viable for urbanization and that invites many environmental issues and health hazards as it increases the amount of Solid Wastes which are not managed properly in the context of developing countries like Nepal. Waste includes all items that people or companies no longer have any use for, which they either intend to get rid of or have already discarded. Many items can be considered as waste, for instance household rubbish, sewage sludge, wastes from manufacturing activities, packaging items, discarded cars, garden waste, etc. Thus all our daily activities can give rise to a large variety of different wastes arising from different sources. However, waste can also be a resource if it is put in the right place and the waste management can be done in a sustainable manner if dealt with it properly.

But if the comparison is made between the urbanized area and traditional area of Kathmandu Valley, it will be lucid that traditional settlements are more sustainable from all perspective including solid waste management perspective. In our research area, urbanized area was taken to be Baafal and the traditional area was taken to be Kirtipur area. Many points were analyzed to see what makes the traditional area more sustainable than the urbanized one. Variants such as lifestyles of people, their economic background, traditional practices and jobs etc were seen to be affecting sustainability aspect from SWM perspective.

One of the reasons that **Kirtipur** is seen to be more sustainable is because of their lifestyles. Almost all the people have kitchen garden in the back of their house. They grow vegetables on their own and the compost prepared is used as a fertilizer in the garden. More than 2/3rd of the Municipal Waste comprise of organic matter which are decomposable. The people have the practice of collecting these biodegradable wastes into a bucket and then composting it which then later is used as a soil fertilizer in the kitchen garden. Furthermore, the people in traditional settlement are mostly involved in agriculture and thus the compost prepared is used as fertilizer in the agriculture as well.


Figure 12: Organic waste collected in the courtyard


Figure 13: Use of compost in Kitchen Garden

Composting is an aerobic process where micro-organisms decompose organic materials under controlled conditions. Composting can be done by individual households or at a centralized compost site. In Kirtipur, mostly individual composting practices were seen to be adopted. The residual product is pathogen free and it is used for improving soil structure and nutrients. Compost is also used to improve the water holding capacity of soil in arid regions. Poor management of the composting process can however, generate a bad smell and even spread vector-borne diseases but no such issues were noticed in Kirtipur. The reason might be because they had garden in the back of their house where people generally do not reside. Hence, there was no such problem of bad odor as such in that area. The method of composting is a very famous and appealing approach to waste management in Kirtipur as it is technically uncomplicated and is cost effective as well. They do not have to pay to the municipality for the waste collection on monthly basis.

On the contrary, the urbanized area, which is taken to be **Baafal** was seen littered by non-biodegradable wastes, mostly with plastics all over. Waste composition is influenced by external factors, such as geographical location, the population's standard of living, energy source, and lifestyles. The lifestyles of people of Baafal are different with the production of more non-biodegradable wastes then the biodegradable wastes. The quantity of plastics in the municipal wastes is high. The Municipal wastes were seen to be dumped in the areas adjacent to the buildings which are not a sustainable practice. These kinds of practices invite many health hazards to people and also degrade and pollute the environment. There are high chances of spreading vector borne diseases which is a threat to the health of the occupants residing in that community.

Figure 14: Municipal Waste Collection

Figure 15: Dumping of Waste in open land

The collection of Municipal Waste were seen to be done by three wheelers (rikshaw) but that was inadequate as the dumping of the wastes were seen done on the open spaces inside the community area. Thus, the Collection facilities in Baafal are inadequate and inefficient where open dumping was seen to be predominant. Final disposal in most of the economically developing countries is usually a matter of transporting the collected waste to the nearest available open space and discharging them and so was with the case of Baafal where the solid wastes were discharged into the Manamati river nearby thereby polluting the river.

Figure 16: Dumping of Waste in Manamati river

9. Sustainable Housing and Buildings

The efficient planning of certain place can contribute to less requirement of energy consumption, ensures thermal comfort and make the buildings cost effective in terms of operational and maintenance cost. The **orientation, use of materials, internal planning of the buildings, ratio of open space to the built space and the height of the buildings** play a vital role in determining whether the building is sustainable or not. The use of locally available materials, the use of materials which requires less energy and the selection of materials used in the buildings which has minimal adverse effect on the environment are the dimensions which can be adopted to produce a building which is sustainable. The material used should be wisely used, not only to ensure the minimal negative effect on environment but also to ensure the thermal comfort of the occupants residing in the buildings and minimizing the functional cost of the buildings. Thus, when the housing and buildings are to be viewed from the sustainability perspective, four dimensions should be taken into consideration:

i) Ensure comfort of the occupants residing in the buildings,
ii) Healthy environment,
iii) Minimum operational and maintenance cost,
iv) Minimum adverse effect to the environment.

On one hand, Baafal is more urbanized area with mostly RCC buildings were seen, while on the other side, in Kirtipur, mix of traditional as well as RCC buildings were seen. Kirtipur is old settlement area while Baafal is recently settled and so in the core settlement of Kirtipur mostly traditional buildings were seen. Variants such as orientation, planning, height of the buildings, materials used, structure of the buildings, functional use are considered while comparing between the traditional settlements (Kirtipur) and urban area (Baafal) with the perspective of sustainability. Parameters under which housing was studied are:

- **Orientation of the buildings:**
- **Structure of the buildings:**
- **Materials:**
- **Height of the buildings:**
- **Functional use of the buildings / Internal planning of the buildings:**
- **Planning:**
- **Thermal comfort:**

9.1. Orientation of the buildings:

In Kirtipur, traditional houses were seen oriented towards an open space called Devpukha in front of temple Bag Bhairav. Traditional houses were also seen along the lane perpendicular to the main axis of Bag Bhairav temple. The buildings in the core settlements are oriented in such a way that there is ample amount of sunlight enters the buildings. There are practices of drying vegetables and making pickles which is an integral part of the lifestyle of the people of Kirtipur, and receiving of sunlight in the terrace allows these cultural practices to be still in use.

In the contrast, in Baafal, the situation was different than that of Kirtipur. There is no systematic planning of the area and the buildings seem to pop up in a haphazard manner. The area was plotted and sold to individuals. The primary, secondary and tertiary roads get branched from the main ring road in an unsystematic manner giving rise to haphazard planning and thus there is no rigid orientation of the buildings. The buildings are mostly oriented towards the roads. The buildings which are oriented towards south east are liale for perceiving sunlight but the buildings which has the entrance from the north side do not get sunlight in proper way.

9.2. Structure of the buildings:

In the core area of Kirtipur, traditional houses were seen to be predominant. While, RCC buildings were also seen to be constructed on the outer periphery of the core settlement. The new houses which were seen to be constructed in the site were also RCC structure buildings. Most of the buildings destructed during the 25th April's earthquake in Kathmandu were traditional buildings. This scenario has impacted the psychology of the people in very negative way. This was reflected in the site as the new construction of the buildings were more RCC buildings. In case of Baafal, the situation was different than that of Kirtipur. This area is recently settled area and there is dominance of RCC structured buildings all over. Traditional houses were hardly witnessed.

The newer construction of RCC buildings is not sustainable. Despite this fact, people are inclined towards the use of RCC buildings as they perceive RCC buildings to be safer and strong. But, from the sustainability point of view, the traditional houses are nuch more sustainable.

9.3. Materials:

In Kirtipur, the building of traditional houses is made up of mud mortar, bricks and timber which are sustainable from the view of reusing them. In the traditional buildings, the inner wall was made of sundried bricks which has the possibility to decompose faster and also were cheaper. Traditional buildings used timber materials in the construction rather the aggregates and cement which RCC buildings uses. In Baafal, mostly every building was RCC buildings. The bricks used were kilned burned bricks, cement, steel and aggregates which are not sustainable materials. The production of cement and steel produces many harmful and toxic gases which degrade the environment. Also, the re-use of these materials are not possible. The mortar used in RCC buildings is cement. If destruction of buildings is witnessed as in the case of natural disasters, then the re-use of these bricks is not possible.

Thus, while comparing the materials of traditional (in Kirtipur) versus RCC buildings (in Baafal), materials of traditional buildings were seen to be much more sustainable from the re-use as well as cost-effective point of view.

9.4. Height of the buildings:

In Kirtipur, mostly the 3 to 4 storey of the buildings was witnessed in case of traditional buildings. The floor height of the traditional building was 7 feet in average. Thus, the maximum height of the building was 21 feet whereas in case of Baafal, multi-storey buildings were seen in the commercial area and the gradual reduction was seen towards residential area. also, apartments also existed in Baafal which was in the construction phase. The floor height of the RCC buildings was 9 feet in general. The houses were minimum 3 – 4 storey thus making the total height of the building to 27 feet. the houses were planned along side of the road and because of more height of buildings, the shadow casted in the adjacent area was much more as compared to that of traditional ones.

Thus, height of the traditional houses in Kirtipur was less than that of RCC buildings in Baafal. The height of the building plays a vital role in light and shade which impacts the overall environment of the living space which is one the dimension of the sustainability. Hence, traditional houses of Kirtipur were seen more sustainable rather than that of Baafal.

9.5. Functional use of the buildings / Internal planning of the buildings:

Most of the traditional houses of Kirtipur were seen to be used only for the residential purpose. Though, few houses were seen to be mixed use. The upper floors were used for residing of occupants whereas in the ground floor, there were shops used by the occupants of the same house. So, the local economy was done in few houses which is also another dimension of sustainability. The transportation cost can be reduced and thus contribute to the clean environment by not having air pollution. The houses of Baafal were divided into three categories: commercial use, mixed use and residential use. One individual building catered for multi functioning such as parlour, restaurants, stationary shops etc. the multi use of the buildings is thus sustainable.

When the function use of the buildings is taken into the consideration, Baafal area was seen to be more sustainable with the multi functioning of the buildings and having local economy to be dominanant.

9.6. Planning:

The planning of Kirtipur as well as Baafal was both compact. The traditional houses of Kirtipur comprised of courtyard system of planning whereas in Baafal, the RCC buildings were constructed more in the form of row housing. The open courtyards in the buildings of Kirtipur were used for kitchen gardening as well as performing some cultural activities. While, in the Baafal area, the row housing was dominant. The built up area in the plot was seen to be very high with no allocation of open and green space for water recharging.

Thus, if the planning is to be considered, planning of traditional hosues in Kirtipur comprised of many courtyards which were left open and green so that the water recharging system could operate whereas in Baafal, the scarcity of open and green space was witnessed which prevents the water recharging system and hence, traditional houses of Kirtipur is more sustainable from planning aspect as well.

9.7. Thermal comfort:

The thermal comfort of the traditional building is also high. Thermal comfort is maintained by the building itself, thus, the active system of heating and cooling the buildings is not required and hence, this reduces the operational and maintenance cost of the buildings. Amongst all the people interviewed from the traditional houses, they said that the thermal comfort of traditional building is very high and the use of active ways of heating and cooling the buildings is very minimal which is in turn cost-effective as well. In the Kirtipur, the core area consists of traditional houses which cater to the thermal comfort to high level. On the other hand, in Baafal, the RCC buildings are dominant. The use of fan and heater was common in the buildings which added up to the operating cost of the buildings.

Thus, from the perspective of thermal comfort of residents, Kirtipur was seen to be more sustainable than Baafal which also adds up to economic sustainability as well as the use of room heating and cooling appliances not used.

10. Water Management:

Water management is an integral part of sustainable community. Water is a form of life as it is one of the five elements of life. Consumption of water ranges from individual uses to community utility. From drinking to cleaning, water is required. For vegetations in the field water is needed. Also the water plays an important role for the aesthetic and architecture. From cultural or religious perspective, water is the symbol of sacredness and is considered holiest of all. The vessel full of water, the well, the fountains, the ponds, the streams all are to be revered. And hence the accessing the water is considered to be very praiseworthy.

Kirtipur is one of the traditional rich urban settlements. It is planned not only to provide shelter for human but also to provide access to land, good innovative architecture and engineering, proper infrastructure and many more. Situated at the hilltop, the supply of water from the down river is difficult. Hence a wise water management had been done by utilizing the rainwater, spring water and underground water in the past. The presence of Jharu, well, hitis and puknus enhance the urban fabric of KirTipur. Watercycle was well understood and planned accordingly. There were pukhus at the center and the peripheral zone for collecting the runoff stormwater. The hitis were made near the forest areas to utilize springs. The dug well were also there to cater the daily lives of people.

10.1. Sources of water:

In kirtipur, various types of sources of water are used. Wide range of sources is used including underground water and rainwater. However, all those water are not potable. Some can be used for drinking purpose whereas some for cleaning and irrigation. The planning that used to cater the people during Malla period has failed to address the present demands. People stay at home more than in the community. The interactions among people are far lesser than it used to be. Water sources and supply method has been changed accordingly.

Kirtipur is compared with the urban strip that covers Nagarjuna Municpality on the west and Kathmandu Metropolitancity on the east. The urban strip is extension of new settlement. There is urban sprawl because of lack of proper planning. Hence the planning and present states of water resources are also different.

10.1.1. Traditional water supply:

Traditional water supply can be observed clearly in Kirtipur than at the urban strip. Some of the ubiquitous elements of traditional water sources are jharu, dug wells, hitis and many more. Traditional water supply system has given significant emphasis on the sustainability of the system and has taken measures to ensure that the natural water cycle was maintained. On the contrary, urban strip possesses some wells only in the name of traditional water resources. Even the well has not been used properly and the state of the well is also not satisfactory as the area around the well has been encroached.

10.1.1.1. Jharu

Jharu is one of the stone spout. This is a small stone water tank that used to provide drinkable water to passerby. There are five jharu at kirtipur (Singh, 2015). Two Jharus can be located at the entry and inside Bagh Bhairab. One that is at the entry is attached with multiple patis whereas another one is placed in order to quench the thirst of the traveler who had walked all uphill. Both of them are not in use. The detail is shown in figure.

Figure 17: Jharu at the entry of Bagh Bhairab

Figure 18: Jharu inside Bagh Bhairab

Figure 19: Steep steps to Bagh Bhairab

Jharu contains the wall support to hold the tank above. Then the water trough comes as we observe upper part, which is single stone to cover the water tank from the front. The funnel like arrangement at the back of the tank can be seen to replenish the trough. Stoppers ate provided on the reservoir to control the water flow. Spigot is the part from where water outflows from the tank. Generally, Jharu are under the guthi endowment. And they are cleaned on 1st Baisakh by guthi to perform ritual praying the water god and renovate it (Maharjan, 2006).

10.1.1.2. Wells:

Wells are very common source of water for domestic purpose in Kirtipur. They are generally circular in shape with an approx diameter of 1.5. The walls are built with brick masonry. These well collect water from shallow aquifer, normally 4 to 6 meters deep. Based on the water quality and depth of water in the well, some well are very popular while others are used for secondary purposes like washing and cleaning. There are nine spring wells at present in a Kiritpur (Singh, 2015).

Figure 20: Well at Bafal

Figure 21: Well at Kirtipur

The wells are also present at the urban strip. The surrounding areas of well are encroached for residential purpose. The surrounding premises of well is not cleaned and used. The water level is very deep in the Bafaal in comparison to Syuchatar side because of abundant agricultural land and open spaces at the Syuchatar side.

10.1.1.3. Hitis

Stone spouts or Hitis are also major water sources of traditional Kirtipur. They were constructed in a large pit on ground so that the sub-surface flow of water can be spouted out for convenient collection. Their sources can be local aquifer or transmitted to the spot through natural sub surface flow or through man-mande channels. Hitis are observed at the periphery of Kirtipur near the ancient *Dhwakhas*. Water from the rajkulo or springs was used to supply water to the Hitis. In case of kirtipur, the hitis are placed near the forest reserves as springs are abundant there. But depletion of forest has dried the hitis.

10.1.1.4. Spring:

Dense vegetation is still present at the rear side of Bagh Bhairab. The trees have been a major means of the ground water recharge. There are many water springs coming out naturally. This water is used for washing clothes and bathing. The springs had been also a good source in time of irregular municipal water supply.

10.1.1.5. Ponds:

Ponds are seen at the core center and the periphery of the Kirtipur. These are generally made to collect and store the run- off stormwater during rainy season. People used to perform their daily activities like washing clothes, bathing, cleaning household utensils at the pond. Some ponds have even cultural significance. For e.g: Dev Pukhu. It is situated at the Bagh Bhairab vicinity. During the evening of Gaijatra, the pond is used to compete among the *lakheys* and award the parts of Buffalo.

10.1.2. Modern water supply

Two main sources of water are the springs at Dudh Pokhari and Sim Jhowahiti, which provide drinking water through a centralized piped water supply system with a capacity of 2200m3 per day for Dudh Pokhari and 1000m3 per day for Sim Jhowahiti. An additional source at Lwangkot, which lies outside the municipal boundary in Machhengaun VDC, has a capacity of 1200 m3 per day and serves the old core area of the municipality. According to NSET, the water consumption for domestic purpose in Kiritpur is 30-35 litres per capita. (Dahal, 2009).

In case of urban strip, water supply is different in planned and unplanned areas. The unplanned settlements are provided with municipal water supply. But it not abundant for the people residing there and hence they use of tanker. Most of the houses have in-built or external water tank for storing the water inside the house. But in the case of planned settlement, water is bored from the property land through pump. Then it is supplied to the topmost level of the area for treatment and purification. Then finally, the water is then supplied to every household at down contour level following the gravity.

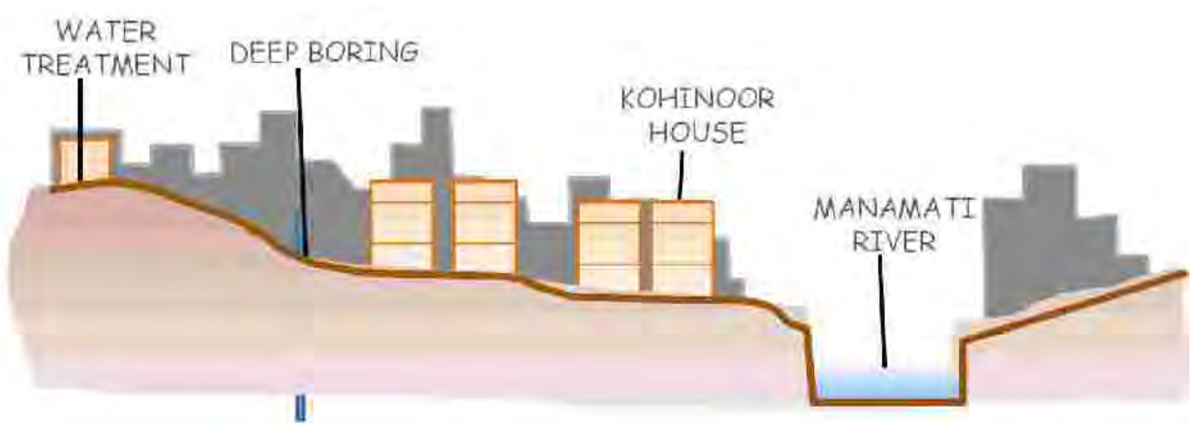


Figure 22: Water supply in Kohinoor Housing

10.1.2.1. Private tap:

Today all the houses which has been registered in the municipality has the private tap inside the house. The private tap is placed at the ground floor and is supplied from the municipal water pipelines. The water from private tap is then transferred to the kitchen at the top floor either through the water pump or manually with the help of buckets and *gha*. Private taps have made the life easier as the time and effort for fetching the water has been decreased. As a result, certain amount has to be paid monthly as per the bill in the branch office of Nepal Water Supply Corporation of both Kirtipur and Urban Strip. In case of Kirtipur, the water supplied is not ample and the inhabitants need supplement water supply. Among survey of 24 households, following outcome has been observed.

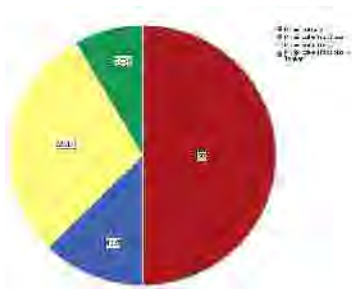


Figure 23: Sources of water

- Every house is supplied with municipal water through private tap.
- But only 50% of houses use supplement water supply
- The family size, user behavior can be few factors that affect the requirement of supplement water supply.
- Traditional water users are lesser than the tanker users which convey that the water deficits in some houses are very large that it cannot be fulfilled by fetching water manually.

10.1.2.2. Public tank:

Kirtipur municipality has provided public tank for the community itself where the water supply is not enough. Both plastic tank and metallic tank are in use. The water is supplied from the municipal line and tanker. There is also a treatment of plant of KUKL near the ring road of Kirtipur.

The overhead tank of KUKL has been observed at the vicinity of Kalanki temple. The area underneath the over tank is used by the inhabitants for social junction where newspaper are read, informal talks are made. There are some street vendors of *Panipuri* and *chatpat*. It is certain that the tank doesn't fulfill the growing demand of water in the urban area and hence the water tanker are used.

Figure 24: Watertank at Bagh bhairab

Figure 25: Watertank at Kalanki temple

Figure 26: Tanker from Matatirtha to Kalanki

10.1.2.3. Tanker

Tankers are vehicles that transport the water from the source to the individual houses for the commercial purpose. Generally water is transported from Matatirtha. The minimum amount of water to order is 10,000 l.

The use of tanker is more in urban strip. Kalanki area is a mixed type of community. There are residences, shops and is a major urban transit. Hence the population pressure is much more, which raise the demand of water. The residents are supplied with tanker water because of their affordability and no other alternate supply.

10.2. Water Conservation Techniques:

Water conservation is an important of environment, economic and social sustainability. Water conservation here means utilization of water wisely. The optimal benefits should be taken from the current available water. Some of the techniques are rainwater harvesting, utilization of grey water, feeding back kitchen garden and ponds. Water conservation prevents the exploitation of the surface water sources and helps maintain the natural water cycle of ecosystem. The optimal utilization of water sources decreases the dependency on alternate commercial water supply (tanker). The social sustainability can be attained through the interaction among the community members while cleaning the pond and other cultural activities.

10.2.1.Rainwater harvesting:

Use of rainwater has been a good water conservation technique as the water supply doesn't meet the demand. And also in an average home 45% of domestic water use does not need mains at all (Bassi, 2011). Examples: drinkable water is not necessary for flushing the toilets or kitchen garden. The survey of 24 houses of Kirtipur shows:

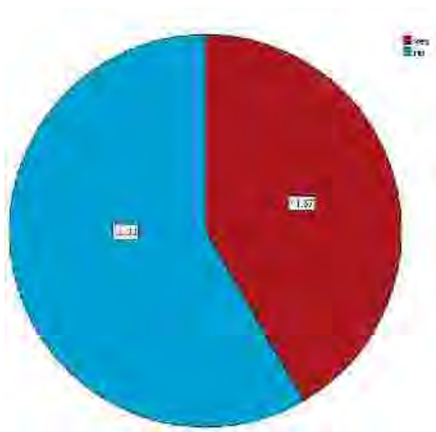


Figure 27: User of rainwater

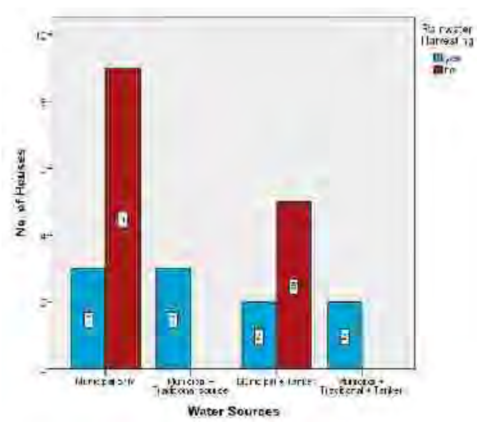


Figure 28: user of rainwater (Supplement water)

- Since rainwater user is less than non rainwater user, the reason could be ignorance about rainwater harvesting. Also, the most of the houses are traditional with sloppy roof and the overhangs are projected outward such that the rainwater goes to the courtyard or the streetside open drainage.
- The houses using municipal and municipal + tanker as main source of water don't use rainwater as the supplement source of water than those users that uses. This may be because of the family size or the high income generating families (who can afford tanker water) respectively. Also, these houses utilize the optimal amount of drinkable water and greywater.
- Utilization of rainwater is one of the behaviors that have been developed after the scarcity of water.

10.2.2.Use of Greywater:

- There is 50-50 ratio of houses that uses greywater for various uses. Some uses for toilet flushing where some for gardening and some for both.
- From left graph, the houses using more than one source of water use greywater than those houses which use one only one source of water.
- As the water demand increases, the requirement of alternate source also increases. And people start using the water wisely. Utilization of greywater can be one of them.

Figure 29: Use of greywater

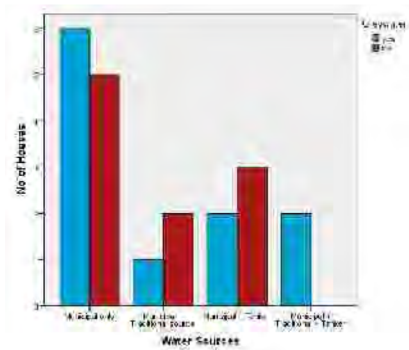


Figure 30: relation between main and supplement (greywater)

10.2.3.Storage of Stormwater runoff and recharging the ground water:

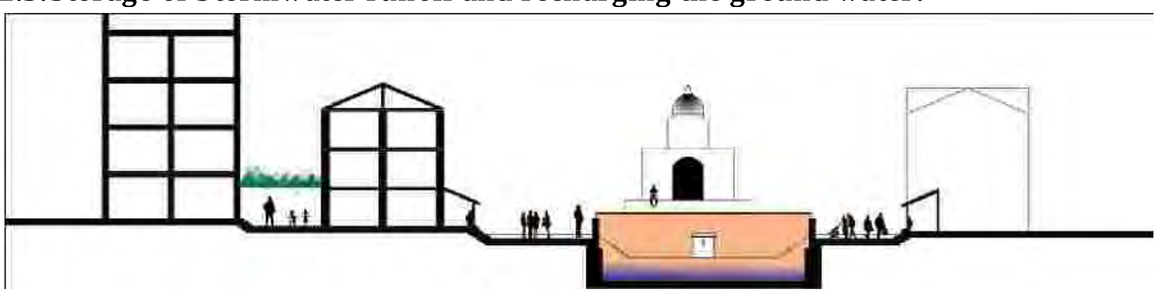


Figure 31: Typical section of Dev Pukhu

The storage of run-off stormwater in the pond is an integral part of traditional planning. It also helps in recharge the shallow aquifers. There are other open spaces which contribute in recharging the ground water. For e.g.: the backyard gardens, courtyard. Through the open joints of the paved courtyard and streets shows the seepage of rainwater into the ground. The backyard garden is devoid of any built surface which helps in recharging ground water. Ware has been managed very well in Kirtipur since the early times taking care to maintain the water balance by recharging the aquifer and by cultural practices that focused on maintaining clean water supply. Also ponds, wells, lakes and rivers as well as the concept of recharging shallow aquifers formed an intergral part of a water supply system in the traditional Kiritpur.

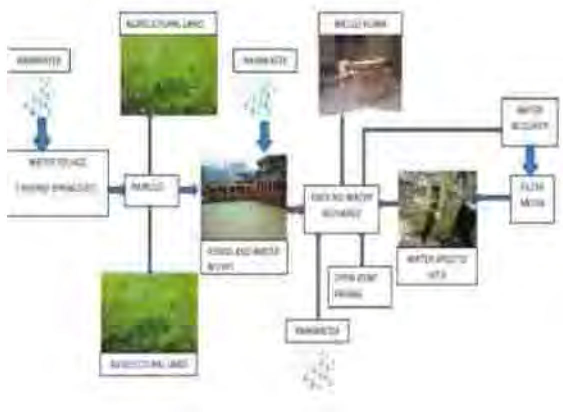


Figure 32: Traditional water supply system in Ktm valley (source: (Singh, 2015)

10.3. Disposal of water:

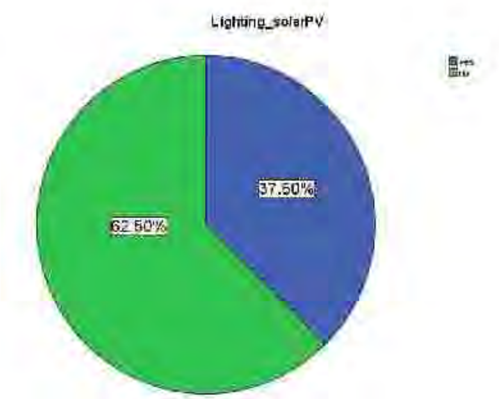
There is no separation of wastewater and blackwater. The disposal water is sent to supplying the city drainage. The waste water from courtyards and streets passes through open drainage and then ultimately to the city line.

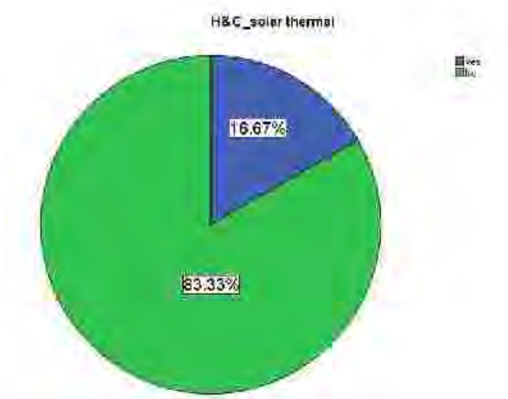
10.4. Recommendations:

11. Renewable Energy

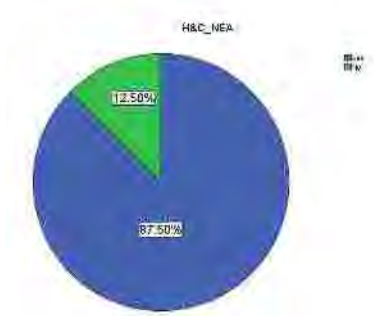
Energy has always been a chief issue and a vital concern in city planning. Its an obvious fact since its a chief determinant of socio-economic activities in society. Efficient energy use from sustainable sources is a discernible fact that people has to incorporate for the overall development. Developing energy efficiency solutions in order to conduct knowledge-driven sustainable social development and operation has been a prime need.

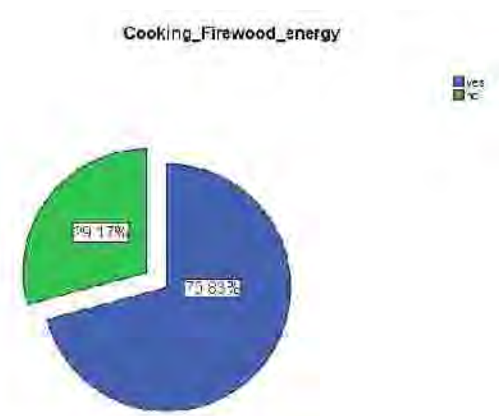
The demand of energy in our study areas is mainly fulfilled by NEA supply. Different electric appliances are used for cooking, heating/cooling, lightning, cleaning and other purposes. But their efficiency and respective loads is not quite considered. In traditional houses in Kirtipur use of solar thermal is very less. Comparitively solar PV is more in use but the capacity is very low, i.e only of 10 to 50 watt. This may be due to high installation cost and unavailability of space. Promoting solar energy in these areas can highly minimize the energy crisis.





LPG is the main fuel for cooking in these areas which is used in almost all household. Due to the unreliable and irregular supply of LPG people keep extra cylinders which is the waste of capital. It has also increased the use of electric cooking appliances such as rice cooker, heater, induction cooker etc. Biomass is also used as the main fuel for cooking in the traditional houses having mud stoves. They mainly use firewood and agricultural residues. There is need of replacing mud stoves with improved cooking stoves for enhancing energy efficiency.





In urban area of our study i.e, Bafal, solar thermal water heater is widely used. Also solar photovoltaic panel is used in many buildings. Here also NEA is the main energy supplier. There is extensive use of electric appliances. LPG is the main fuel for cooking while the use of biomass fuel is very less.

11.1. Energy for thermal comfort

Buildings consume a lot of energy all around the world and are responsible for high environmental pollution. Buildings represent 32% of total final energy consumption (IEA, 2016). Major portion of building energy is spend on maintaining thermal comfort. Therefore proper consideration is required while providing thermal envelope. A thermal envelope is everything about the house that serves to shield the living space from the outdoors. It includes the wall and roof assemblies, insulation, air/vapor retarders, windows etc. While design costs, options, and styles vary, most energy-efficient homes have some basic elements in common: a well constructed and tightly sealed thermal envelope; controlled ventilation; properly sized, high-efficiency heating and cooling systems; and energy-efficient doors, windows, and appliances.

The traditional houses in kirtipur provide good thermal comfort to the people. These building has less floor area, smaller rooms, thick load bearing walls(450-600mm), 3-4 storeys, smaller floor height(about 6-8ft). The exterior exposed layer of the wall is of brunt bricks to resists weather effects while the inner wall is of sun dried bricks. Ground floor is used as utility room and storage, middle floor as bedroom and living room whereas the top floor is mstly used as kitchen, dinning, puja rooms. These features are scientific and wise adaptive way to provide thermal comfort to the occupants. As (Bajracharya, 2014), Compare to modern residential buildings, the traditional buildings are 1 to 2°C warmer in winter and 1 to 2°C cooler in summer. This may be the chief reason for less use of energy for maintaining thermal comfort in traditional houses in kirtipur.

But in case of urban settlement in Bafal, energy consumption for maintaining thermal comfort is high. Some of the houses use AC whereas appliances such as fan, room heater are highly used in most of houses. This may be due to poor thermal quality of a building envelope: walls, insulation, windows.

Figure 33: Traditional house, Kirtipur

Figure 34: Modern house, Bafal

12. Enhancing sustainability through seismic resistant structures:

Nepal is located in highly earthquake prone zone. The devastating earthquake hit on 25th April 2015 simply proves the former statement. Entire Nepal where most of the land is covered by the Himalayan Mountains falls under the highly seismic zones. Because the Himalayan mountain range was formed by the collision of the Asian and Indian plates that started about 50 million years ago. Nepal being in a highly earthquake risk area, the concept of sustainable development cannot go ahead without incorporating the seismic resistant structures. The recently faced destructive Gorkha earthquake has taken no of lives, leaving much of the people homeless. Peoples, who luckily managed to survive in earthquake, lost their lives during the winter by cold due to the lack of proper management by the government. So if is really to gain the sustainable social development, it is must to get prepared for the natural disasters to come.

During our field visit to kirtipur, we tried to observe the effects of Gorkha earthquake in a small locality of Bhagvairab tole. Traditional settlements are considered more vulnerable to the earthquake. But during our visit to that traditional settlement of kirtipur, the damage due to earthquake was not as that as we imagined.We could find there ample no of traditional buildings which remained intact during the earthquake. And the reasons, the structures remained intact during that devastating earthquake were not other than they had simply followed the basic assumptions of the structural safety. Some of the earthquake resistant measures found in traditional buildings are;

12.1. Symmetry:

For earthquake resistant design, it is important that center of mass and center of rigidity of building is nearly coincident (center of rigidity is defined as geometric center of stiffness of various elements of building). However this torsion problem is well taken care of in many traditional houses by having same size of opening in opposite wall that is the openings have been symmetrically arranged around the centerline of the structure, thus making the rigidity of opposite walls the same. This causes no excessive torsion because the center of mass and center of rigidity coincides in traditional building.

12.2. Double framing of Openings:

Great care has been taken in design of openings are the critical section of a wall panel during earthquake. Traditional houses have two complete frames of timber (tied to each other) around the openings to strengthen it against lateral force. Also location of openings has been carefully controlled keeping all windows at least 3 feet away from corners so as not to weaken them.

12.3. Monolithic character of the structure using horizontal ring beam:

Emphasis has been given for monolithic character of structure so that earthquake force is resisted by the building as complete unit rather than by individual parts. Horizontal ring beams have been used in the walls at every floor to tie the whole structure, and also to distribute the load uniformly to all parts of the building. For example, when the earthquake force is operating in the direction parallel to central wall. The center wall also with two exterior walls acts as shear wall and take up the earthquake force. The ring beam on top of these walls will distribute the stresses uniformly to the whole building. When the earthquake force is acting in the direction perpendicular to the central wall, the timber joists at every floor will transfer the load to the central wall and two other external walls. The ring beams on all the walls have got another function also to support individual floor joist in case of local failure of the bearing walls. Without the ring beams, if there is a collapse of a part of the wall, the chances of collapsing of the floor joist resting over the wall at the same time is also high.

12.4. Roof held tightly to the Wall:

Generally during strong earthquakes, sloping roof tend to slide off the wall thus shearing the wall element also in the process. However in many traditional Newari houses, roof is held tightly to wall be extensive use of wedges and tie members.

12.5. Use of "Chokus" or Wedges:

One remarkable feature of the traditional houses of Kathmandu is the system of "Chokus"- that is the timber wedges used to secure various joists in timber member. Generally, floor joists are held tightly to wall by putting wedges on both sides of the wall rather than inserting inside it. This way, the joint becomes a pinned joint rather than a rigid joint, because if one blows up the joint between wedges and wall there will still be a tolerance between the wall and wedge. Due to this gap between wedge and wall, load transfer from one wall to another will not be complete until the floor joists moves through this tolerance (or gap) during earthquake. In this process of moving the floor joist by the tolerance distance, some energy will be absorbed by the floor joist which is equal to the work done in moving the joist- that is seismic force x tolerance distance. Thus this mechanism of wedges serves a dual purpose of providing structural integrity between floor joists and wall, and at the same time absorbing some portion of earthquake energy thus reducing the earthquake effect on the building. The jointing systems in wooden wedges have certain advantages over that with nut and bolts. They are 1. The wooden wedges do not rust like nuts and bolts in course of time; 2. Wooden wedges have the same coefficient of expansion as the wooden joists to which it is fixed, whereas iron bolts have different coefficient of expansion with respect to wooden joist. Hence during temperature changes, wedges fare better than iron bolts; 3. Wedges, unlike rigid joints in nuts and bolts are ductile in property, and have slight flexibility of movement, which is desirable for earthquake resistance.

In this way, some of the traditional houses were seen incorporating the seismic resistant measures .But the other traditional houses which were not incorporating the seismic resistant parameters, were more damaged or even collapsed too. So through the observations we simply can say that the traditional buildings can also be made seismic resistant through incorporating the above mentioned parameters. Common people basically understands that only the frame structured buildings are earthquake resistant , but unlike of that , the traditional buildings using the locally available material can also be made earthquake resistant through various parameters being considered. So it seems must to develop seismic resistant structures(if possible ,with the use of locally available materials) in order to promote the sustainable development.

13. Conclusions:

This study was focused in analyzing the various factors contributing to sustainability, in the traditional settlement of Kirtipur. Our objectives were mainly to observe the sustainability parameters within the traditional settlement of kirtipur.This report, to some extent also covers the sustainability study of the Bafal area which is the urban settlement.So this report, not in a depth, but in a surface, tries to compare the urban and traditional settlement within the various sustainability parameters. This report is actually based on the one day field visit to the kirtipur. During the field visit, the data were collected mainly based on the observations using various maps, photographs etc and very few (only 24 sets) of datas were collected through household survey. With these few sets of datas, however we cannot generalize the results to whole kirtipur but this study can be more reliable to the core settlement of the Bagbhairav area.

The land use map shown in early chapters clearly depicts that the low density areas are emerging at an alarming rate towards the highly dense areas thereby significantly reducing the agricultural and the forest areas.The Google earth map of the year 2015 and 2005 distinctly shows the changing landuse pattern thereby not giving continuity to the traditional sustainability parameters. The traditional buildings were observed to be using locally available materials thereby contributing to the thermal comfort and reducing the active energy consumption. But the new constructions were seen using more unsustainable building material thereby increasing the energy consumption and GHG emissions. The road networks within the traditional settlement were found amazing in a sense that, most of the road loops consists of temples, open spaces etc after walking through certain distance,thereby promoting the walk able city and the open spaces significantly contributing during the time of disasters. The scenario of solid waste management is seen quite satisfactory, as about 60% of peoples surveyed answered that they are practicing separating the biodegradable and non biodegradable waste. However the use of saga is almost nill thereby incorporating the unsustainable means.The closed loops in managing the solid waste are now changed to open loops thereby creating really a problem in wastemanagement.Most of the ground water resources especially wells were found to be dried thereby indicating low groundwater recharge system. The use of solar energy is significantly low (only 16% uses solar thermal and 35 % uses solar pv), thereby indicating that the settlement is heavily dependent on either the traditional solid biomass or the fossils fuels. However the street lights were observed using solar energy thereby meeting the energy demand through renewable energy technology. The effect of earthquake in the traditional settlement was not found to be such devastating which used to be imagined. And this shows that the earthquake resistant structures can still be made with the use of locally available materials and local skills thereby promoting the energy efficient structures.

14. Recommendations:

During the study of the particular area of Bagbhairav tole in Kirtipur, there exists some of the unsustainable practice regarding various parameters. There seems to be increasing haphazard sprawl of human settlement thereby reducing the agricultural and forest areas and increasing the built up area, and this is not a sustainable behavior , which can create serious problems in near future. So it is to recommend that if there is to expand the settlement it should better be compact thereby protecting some agricultural and the forests areas.The use of the locally available building materials is being reduced and the use of other sophisticated building materials has been dominant thereby increasing the energy consumption and GHG emissions. So it is to recommend using the locally available building materials especially in the residential areas thereby reducing the energy consumption and GHG emissions considerably. In looking at the context of solid waste management it is to recommend following the closed loop of managing the solid waste thereby utilizing the waste in every manner. Most of the wells and ponds were seen dry, in lack of proper conservation of water and not providing sufficient area for groundwater recharge. So it is must to leave the area around water resources unpaved, so as to allow the water to infiltrate. Enhancing the rainwater harvesting could also be the better option in meeting the water demands. The use of renewable energy is not seemed to be satisfactory in the study area .The use of solar energy should be made extensive in meeting the increasing electricity demand thereby enhancing the clean and green energy.The current devastating earthquake has proved that the how the unsafe structures can take the valuable lives.So it is to strongly recommend to build the structures by following all the norms and standards thereby leading the society towards the sustainable development.

14.1. Recommendation on Landuse:

As the year passes by there is an increament in the built forms reducing the size of the agricultural areas, flat and steep cultivated areas which can be seen in the google maps. Therefore, it is necessary to look the sustainable aspects and proposals should be made to prevent from the haphazard urbanization. From the history, most of the people living in this area are found to be farmer so their main occupation is Agriculture. Hence, the agricultural lands needs to be proposed for the future as well as development of compact settlement near the main core area for the easy access of services and facilities.

14.2. Recommendation on Transportation:

As various factors guide the sustainability of transportation such as Sustainable Alignment, Material and Resources, Storm water management, Energy and Environmental Control, construction activities, Innovation and Design etc. So, these factors should be taken into consideration. It is recommended to plant the trees along the road, have separate lanes for the bicycle, Pedestrians etc for maintaining the road sustainable.

14.3. Recommendation on Socio-cultural Aspect:

Socio- cultural aspect also being one of the important social aspects. These things should be taken into consideration especially in the streets, Cultural Sites along with the cultural routes where the different festivals are carried out and the resting areas such as patis etc. It is recommended to preserve these areas in terms to continuing these aspect for the longer period of time.

14.4. Recommendation on SWM:

- Sundried bricks could be used in internal walls.
- Timber could be used with proper maintenance.
- Height and width ratio should be properly maintained to incorporate sunlight.
- Laws regarding constructing houses should be implemented.
- Construction of traditional houses should be emphasized.
- Height and width ratio could be properly managed.

14.5. Recommendation on Housing:

- Community composting could be promoted.
- End users for composting should be defined for enhancing economy.
- Generation of solid waste should be minimum by changing the practice.

14.6. Recommendation on Water Management:

On the basis of the observation and literature review, some recommendations have been made.

14.6.1.Revival of Jharu:

Jharu has been a bird inside the cage. It has its significance both as a water source and an architectural entity. But now, the value of jharu has been limited only to see than use when the main objective of jharu was to quench the thirst of the passerby. Watertank and a tap had been constructed near the jharu for water supply but jharu was not revitalized. If jharu was to be revitalized then, there would not be any need of the modern public tap. Yes, problems can be encountered in case of water supply and quality of water. But modern technologies can provide multiple solutions. The picture best describes the revival of Jharu.

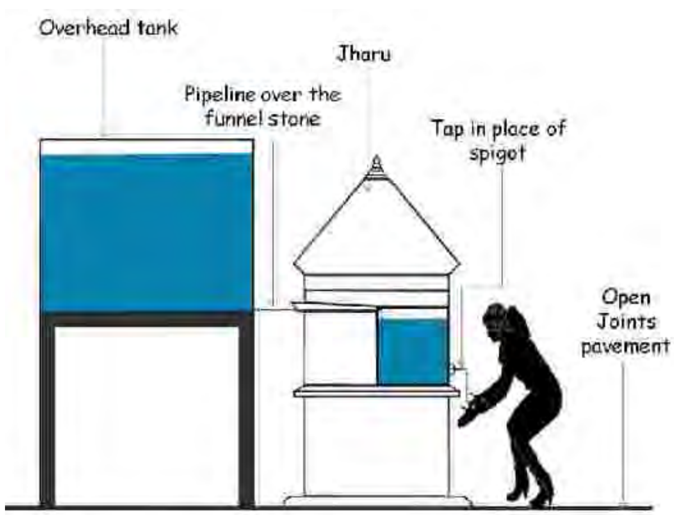


Figure 35: Revival of Jharu

14.6.2.Proper rainwater harvesting:

There should be proper rainwater harvesting system from the buildings. A proper rainwater collection increases the quality of collected rain water and decreases the dependency on the main water supply. A proper rainwater harvesting system requires catchment area, the conveyance, storage and delivery.

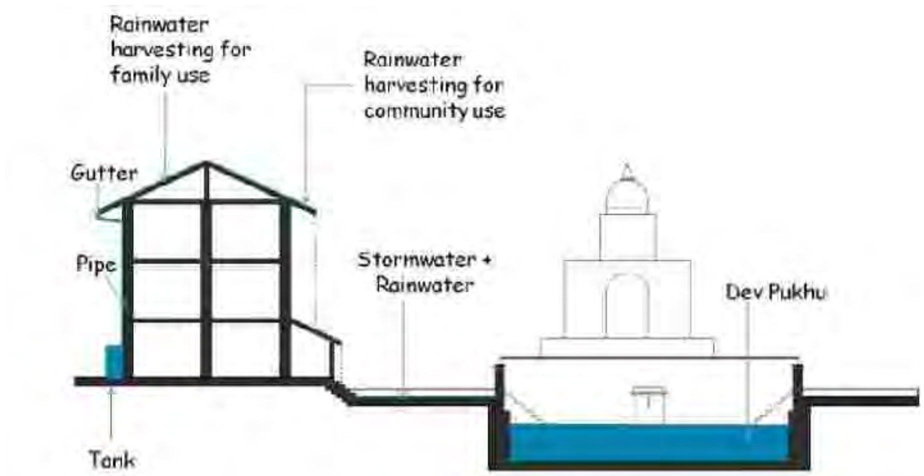
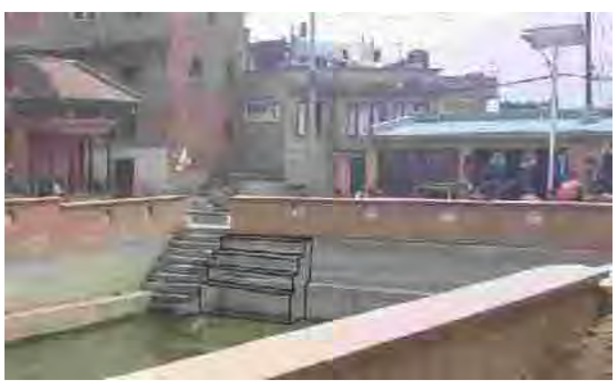


Figure 36: Rainwater harvesting for dual use

As seen in above picture, the rainwater is harvested both for individual family use and community use. The slope roof is catchment area for rainwater harvest. The portion which faces the pond should contribute the water to the pond whereas the rainwater can be harvested for family use on the other side. For that, the overhangs are to be provided with gutter along the fascia board and then connected to the own pipe and finally to the storage tank.

14.6.3.Filtration of stormwater:

Ponds are fed with the poor quality stormwater which lacks filtration. As a result, the pond is filthy and looks more like frog farming. The quality of pond water can be increased through a natural filter bed. The water is filtered in the natural filter bed before supplying to the pond.



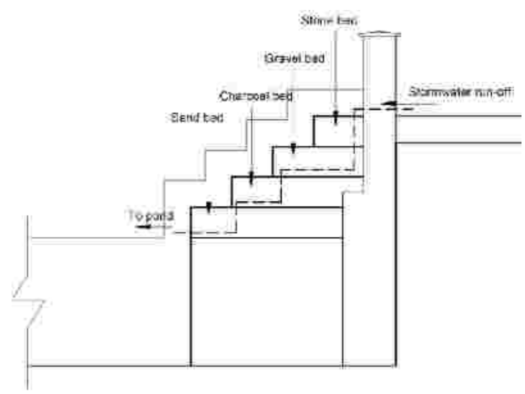


Figure 37: location of Filter bed in Dev Pukhu

Section of Stormwater filtration

14.6.4.Revitalization of courtyards:

Near the Bagh Bhariab area, there used to be 7 chowks of Amatya clan. Now there are only vestiges. Out of 7, only 5 have access now. The access to other two courtyards was blocked be the rubble of houses led by earthquake. The present condition of chowks is not good enough. Some are abandoned where as some are used for disposing the waste water and solid waste. But the central chowk has already been revitalized with the help of municipality fund. And another one is on the process of revitaliazation. At first the courtyards should be revitalized following the traditional principal and materials. Since 50-70% of the rainwater incident could be harvested from the paved surfaces (Bassi, 2011), the storm water collected from these courtyards can be used to revive the ponds, to recharge the groundwater. There is also a possibility of micro retention pond for the irrigation of back kitchen garden, cleaning purpose, emergency of fire hazards as well. At the end, the community looks clean and beautiful and can be developed as the major attraction for the tourists.

Figure 38: 7 chowks of Amatyas, Hwakucha

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Suitable Sustainable Municipal Solid Waste Management Approach for Kathmandu

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Abstract: **With the growing population due to urbanization and industrialization in most of the cities of the world, the amount of Municipal Waste Generation is also increasing. The composition of these wastes is also changing due to factors such as change in lifestyle, economic development, consumption pattern etc. On top of that open dumping is practiced heavily as a method for municipal disposal worldwide. This leads to unsustainable way of handling the Municipal Solid Waste. There are approaches available which helps in the sustainable solid waste management. But the selection of** strategies has to be tactfully thought beforehand that the failure in the application can be avoided. Hence**, this paper has the aim of recognizing which approach available is best fit in the context of Kathmandu.**

Key words: Sustainable Solid Waste Management, MSW (Municipal Solid Waste), RFID (Radio Frequency Identification), RDF (Refuse Derived Fuel), Hybrid Gasification and Incineration, PAYT (Pay As You Throw)

1. Introduction

Globally cities face environmental challenges and have to deal with the climate change issues. Urbanization is taking place at a high rate and along with it comes the rapid population growth and the increase demand of energy. Not only the consumption demand increases but the waste production that it brings is embarking. The situation worsens with the inefficient way to handle the growing waste production and can become a burden. The environmental issues and health hazards by haphazard management of Municipal Solid Waste (MSW) is converging the focus of the people towards sustainability in al perspective. The main idea is that cities should be deal all the aspects such as use of water resources, management of solid waste, use of energy, consumption of energy etc. with a vision of sustainability.

Solid waste management (SWM) is one of the major environmental issues in cities of many developing countries, including Nepal. Urban population growth and economic development lead to increasing generation of municipal solid waste (MSW). On one hand, the population is increasing at a high rate but on the other hand, no efficient ways of tackling with the waste produced are considered which is creating a burden not only at the local level but at the global level as well. Rapid and haphazard urbanization, lack of public awareness, and poor management by municipalities have intensified environmental problems in cities in Nepal, including unsanitary waste management and disposal. While solid waste management (SWM) has become a major concern for municipalities and the country as a whole. Environmental pollution as well as health hazards is derived from unsanitary solid waste management. The approach to deal with municipal solid waste in a sustainable manner in not only the work of government's side but has to be dealt from the local level for the appropriate and successful results. Unmanaged disposal of wastes contribute to pollution and public health hazards in the localities. Therefore, SWM has become a major concern for the municipalities of Nepal as sustainable municipal waste management has the ability to not only reduce GHG emissions and drop the CO2 and methane gas into the environment, thus ensures the health of the people and a clean environment.

2. Objective

Main objectives:

- To find the sustainable approach of Solid Waste Management.

Specific objectives:

- To determine the current practices of municipal SWM in Kathmandu.
- To recognize the possible ways of sustainable Solid Waste Management approaches.
- To identify and analyze which approach of sustainable solid waste management best fit in context of Kathmandu.

4. Methodology

The research is based on the literature review. The research has attempted to make an explanation on 'How' the solid waste produced in the Kathmandu City be managed in a sustainable manner. Relevant literature review was done and then the data was analyzed to find out which are the solutions that are best fit in the context of Kathmandu in terms of Municipal Solid Waste Management.

5. Study Area

Kathmandu valley was taken as the study area. It is the capital of Nepal.

6. Rationale of Selection of Study Area

More population and their consumption pattern give rise to more production of solid waste. Kathmandu city being the capital of Nepal is prone to urbanization at a very high rate. As per the data collected Kathmandu Valley has 9% of total population of Nepal and has the rate of urbanization as 4.35% which is higher than the rate of urbanization of Nepal which is 3.62% (Rajbhandari US, 2014).

With the growing urbanization and industrialization the economic level of the people also rise with give rise to change in consumption pattern and thereby producing the composition of Solid Waste as well. Though the urbanization rate is high in valley, the planning and management of SWM is very weak. The practices such as haphazard dumping of the municipal waste into rivers, collecting and incinerating the municipal waste in an open space without the segregation of combustible and non-combustible waste and no segregation of biodegradable and non-degradable waste before dumping to the landfill area are inviting health hazards to the people as well as threatening the global environment.

With the rapid urbanization and unplanned waste management in the capital, it is facing the problem of SWM system which is projected to worsen in the future years to come with even more population residing and the poor management of waste which is prevailing. Hence, Kathmandu is selected as the area of study so that possible appropriate solutions can be drawn to reverse the city of waste to an eco-city through the planning of SWM.

7. Validity of research:

In spite of the large potential of SWM system in contribution to clean and a healthy city, much remains yet to be achieved. Though the prevailing SWM system has been studied previously, the way of handling municipal waste from the perspective of sustainability in Kathmandu is yet to be discovered. Thus, this research is validated.

8. Literature Review

8.1. Present Scenario of SWM in Kathmandu

8.1.1. Municipal Solid Waste Generation and Composition

The average composition of MSW from three sources i.e. Household Waste, Institutional waste and Commercial Waste is as follows: organic waste 56%, plastics 16%, paper and paper products 16%, glass 3%, metals 2%, textiles 2%, rubber and leather 1%, and others 4%. The analysis of waste composition showed that organic matter accounted for the highest fraction, making up 66% of household waste and 43% of commercial waste; while the largest fraction for institutional waste was paper and paper products at 44%. The survey showed that there is great potential to promote composting of MSW in all municipalities. (Solid Waste Management in Nepal., 2013).

8.1.2. Existing Solid Waste Management System

- *Collection and segregation*

The study found that about 30% of surveyed households in the municipalities practice segregation of waste at source. Analyzing the information provided by the municipalities, the present collection efficiency ranges between 70% and 90% in major towns . However, this may be overestimated by the municipalities due to the lack of scientific recording systems. Citizens dispose of waste within their compound either by unscientific composting, open burning, or throwing the waste in the surrounding open space. Collection, city cleaning, and sweeping is not done on a daily basis except in main markets, along main roads, as well as in residential areas. (Solid Waste Management in Nepal., 2013).

- *Transport and Final Disposal*

The vehicles and equipment available for waste collection and transport in each municipality varies widely. Vehicles commonly used include rickshaws and carts for primary collection, tractors for secondary collection or transport, and dump trucks for transport to the disposal sites. Open dumping, including riverside and roadside dumping, is heavily practiced creating public health risks and environmental problems. KMC and Lalitpur are facing the problems including frequent local protests, lack of proper management, and unavailability of necessary equipment, leading to unsanitary methods of disposal.

8.1.3. Solid Waste Management Policy and Legislation

Among the acts and policies pertaining to SWM, the 2011 Solid Waste Management Act and the 1996 National Policy on SWM are particularly relevant. The National Policy on SWM was formulated in 1996 to address the emerging SWM problems due to urbanization. The policy emphasizes waste management in municipal and urban areas and is still in force. Its main objectives are to (i) make SWM simple and effective, (ii) minimize the impact of solid waste on the environment and public health, (iii) treat solid waste as a resource, (iv) include private sector participation, and (v) improve public participation by increasing public awareness about sanitation.

8.1. Different Approaches for sustainable Solid Waste Management

There are many approaches towards sustainable solid waste management. The approach can be from various stages from decision making level, management level to system involved in carrying out the waste management level.

8.1.1. Life Cycle Assessment of Reusing Fly Ash from Municipal Solid Waste: A Case of Taiwan.

Fly ash is the residual substance that is left after the incineration of Municipal Solid Waste. As landfill capacity in the country is limited, this vast amount of fly ash should ideally be reused. However, fly ash has worse impact on the environment because of which some treatment methods should be applied before using fly ash. There are three types of treatment methods available:1) Extraction and separation,2) Thermal treatment, and 3) Stabilization/solidification. Amongst all these methods, thermal treatment has the maximum efficiency but expensive. Extraction and separation methods are the simplest but it requires a lot of energy consumption. The stabilization method is thus the most appropriate in terms of efficiency as well as cost-effectiveness. These methods separate out the hazardous components such as dioxides, furans and heavy metals such as Lead and Zinc. There are various process of reusing the fly ash. Four of them are: 1) landfill after solidification, 2) reuse as cement after a washing process, 3) reuse as bricks after a washing process, 4) reuse as alkaline in the waelz process of steelmaking.

A case study was carried out in Taiwan for realizing the best process of reuse of fly ash from MSW by assessing the impact on environment.

- *Characteristics of fly ash from MSW incineration*

MSW fly ash is composed of many toxic substances, with the majority metal salts, but the composition of fly ash does differ somewhat from country to country. The fly ash was collected from the incineration of MSW in northern Taiwan. It was found that the major components of this fly ash were 22.08% SiO_2 and 12.44% CaO.

- *Life cycle assessment framework*

The environmental impact of fly ash was compared in four processes of reuses of fly ash. Life Cycle Assessment framework is the tool which was used to identify the best process of reuse of fly ash.

- *Impact assessment: scenarios*

1) Scenario 1: Landfill after solidification

The most common treatment of fly ash in Asia is disposal to landfills after solidification. After the washing process, the fly ash is mixed with cement and a chelating agent for stabilization, after which the solidified product is transported to a sanitary landfill site.

2) Scenario 2: Reuse as cement after the washing process

After the water wash and chelation, 10% fly ash was added to the raw cement materials that include limestone, clay, sands, and iron ore.

3) Scenario 3: Reuse as bricks after the washing process

After the water wash and chelation, 20% of the fly ash was added to the raw material for making bricks.

4) Scenario 4: Reuse as alkaline in the Waelz process of steelmaking

In scenario 4, the fly ash from the incineration of MSW was water washed and subsequently about 7% of the fly ash was added in the Waelz process for the treatment of EAFD. (T.Y. Huanga, 2015)

- *Comparison of the environmental impact of all the scenarios*

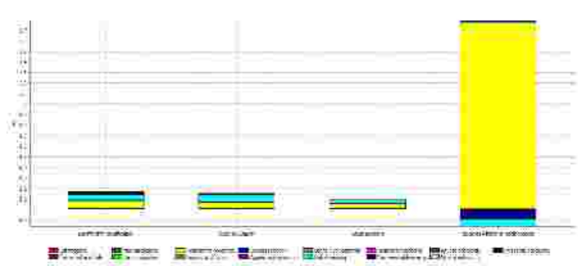

Figure: Comparison of the environmental impact between the four scenarios

Based on the environmental impact, this study assessed four scenarios to find the best treatment for fly ash. It was concluded that of the four options assessed, reusing fly ash as bricks was the most environmentally friendly treatment. In scenario 3, reuse as bricks, the hot spot of impact was in the washing process and pollution emission of the reuse process. Therefore, reducing the air pollution emission and finding a more efficient treatment for wastewater would be crucial to reduce the impact of this fly ash reuse method. However, this study cannot be considered as a complete assessment, as only one aspect of reuse treatment was evaluated. In future, we will also consider the cost-benefit and risk management aspects to select the best treatment for the reuse of fly ash (T.Y. Huanga, 2015).

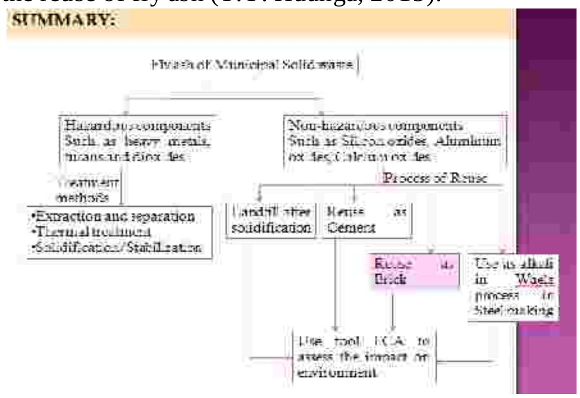

Figure: Graphical summary of the
Re-sue of Fly ash

8.1.2. RFID enhanced PAYT approach: A Case of United States.

Americans produce a staggering 254 billion tons of trash each year. This represents an approximate 300% increase over the past 50 years. And due to a wide range of economic, political and environmental factors, the number of landfills for all this "stuff" to be deposited into has markedly declined. There are already severe shortages of landfill space in pockets of the country. In fact, six states - Alaska, Connecticut, Delaware, North Carolina, New Hampshire and Rhode Island - have less than five years of landfill capacity remaining.

Single rate model:

Traditionally in the United States, trash collection has been a service performed by municipal governments - for a flat fee –for its citizens. The flat rate system provides no incentive for individuals to reduce the amount of waste they put out for collection. It is not inequitable, but actually harmful to the environment as well.

Pay As You Throw:

Then there was the introduction of "Pay As You Throw" (PAYT) system. Under the PAYT model, people pay a variable rate, based on the amount of trash they actually put out to be collected by the waste management contractor. Such long-standing PAYT systems have not gone without issues, including residents intentionally depositing their trash in other people's containers (to avoid their own charges) and a limited rise in the illegal dumping or burning of trash in remote areas.

RFID enhanced PAYT model:

Then, came RFID enabled PAYT model which was the most efficient amongst all previous systems. Texas Instruments has been a leading proponent of using auto-ID technology to not just better the business intelligence of waste management contractors (enabling them to monitor their fleets and worker performance, both for optimizing routing and quality assurance, especially when combined with GPS that is already in wide use in the industry). Specially-equipped garbage trucks can then weigh each "smart" trash can upon collection, making it possible to ascertain the "net amount" of garbage collected from each customer each time each customer's trash is gathered. The collection process can remain unchanged from what it is today, as the weighing is done as the can is lifted and emptied into the trash truck by the operator, thereby not slowing down the present system performance.

Municipal Solid Waste market holds the potential for rapid development over the next few years for RFID solutions providers, as well as those vendors providing the hardware and software necessary to support PAYT and for monitoring recycling. In fact, today's economic conditions could work to benefit solutions providers in this area by accelerating the growth of both the PATY and recycling incentive programs, both in the U.S. and abroad (Wyld, 2010).

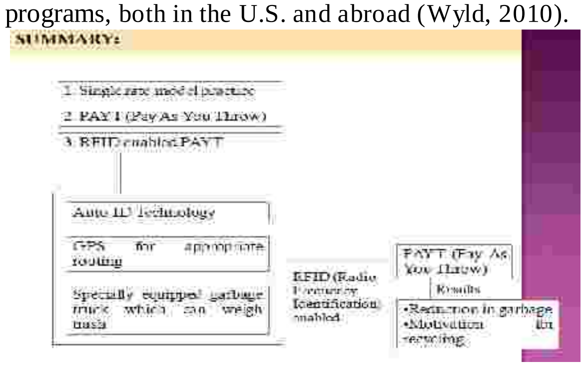

Figure: Graphical summary of the
Use of RFDI enhanced PAYT system

8.1.3. Selection of Hybrid Incineration and Gasification system: A Case of Maiked, Thailand.

Waste characterization:

To adopt the strategy of Hybrid Incineration and gasification, first an overview of composition of Municipal waste is required. Approximately 1 m3 of waste at the dumpsite was taken at Maiked as a sample for determining the physical and chemical composition. The physical composition of the waste, which is the main criteria for selecting the appropriate technology, was investigated. The results found was Similar to other rural areas in developing countries, the MSW generated in Maiked had a high percentage of organics waste (wet fraction), e.g. kitchen waste and yard waste, which amounted to 44.2 -wt. of the total. The remaining was a dry fraction, comprising plastic, paper, cloth, rubber and trace amounts of non-combustible material, e.g. glass, metal and hazardous waste (Kerdsuwana S, 2015).

Appropriate selection of technology:

Two cases were taken into account:

Case 1: The MSW could not be separated and all of the MSW was treated as mixed waste

Case 2: the MSW could be separated

Considering the selection criterion mentioned in of case 2, composting was the appropriate technology for wet fraction (organic waste) disposal since it is widely used and reliable, with no difficulty in operation. Based on viewpoint of economics, this technology requires low investment and operational costs. Additionally, it can be operated in the community households. Regarding the remainder from the separation process, which was referred to as the dry fraction, incineration was selected as the promising and ultimate technology to treat the dry waste since it can effectively reduce the volume of the mixed MSW, which has high flexibility for a non-homogeneous composition. This incineration technology has been commercially. However, this technology requires energy, normally from fossil fuel, for the combustion process in order to maintain the desired operating temperature; consequently, there are high operation costs. Hence, it is suggested that gasification technology be used in combination with incineration technology to produce producer gas, which can further be supplied in the incineration system as substitute fuel for fossil fuel. The conceptual design of the overall process for the MSW disposal technology, focusing on the incineration technology for dry waste, is illustrated in figure below:

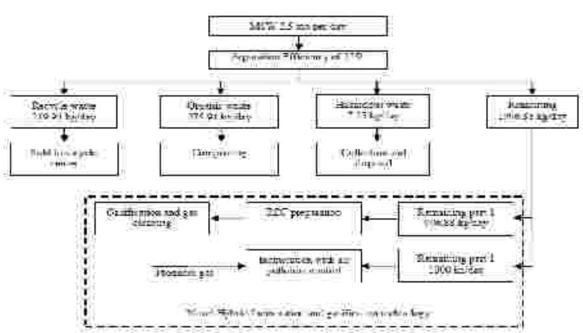

Figure: Conceptual design of the overall process for MSW disposal technology focusing on the novel hybrid incineration and gasification technology

The proper technology for the disposal of MSW in a rural area is controlled air incineration integrated with downdraft gasification. This combined technology has a dominant advantage in terms of reducing operation costs. The producer gas obtained from the gasification process can be used as a substitute for fossil fuel in the controlled air incinerator. The central government should support the LAO in terms of financial funds in order to invest in the necessary technology because MSW management is the responsibility of the government (Kerdsuwana S, 2015).

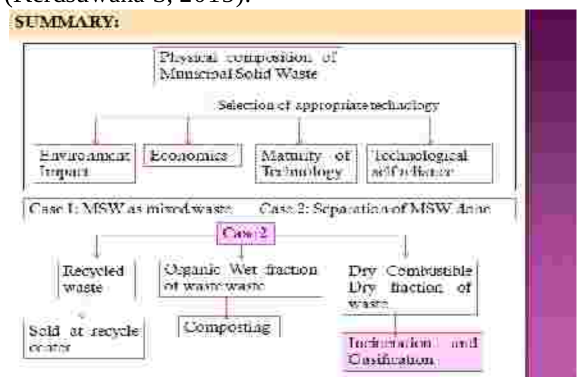

Figure: Graphical summary of selection of appropriate technology for sustainable approach to municipal solid waste

9. Selection of appropriate approach for Kathmandu

From the literature which was carried out, it is clear that the approach to deal with the waste management varies according to economic, social, political factors of a country.

Since Nepal is a developing country, there are problems which are prevalent. Amongst all the problems such as public unawareness, poor management of waste etc, lack of funding come as a prominent problem. Hence, the approach which has taken into consideration the financial problem should be preferred and adopted. Amongst all the approaches that has been described, the hybrid system of incineration with gasification is most cost-effective.

Also, though Kathmandu city contains laws and regulations regarding solid waste management but they are not being practiced well. The prevailing laws are very generic and open ended. Thus, action has to be taken from the management perspective as well. Thus, RFID enhanced PAYT system seems to be effective in the context of Kathmandu but the cost-analysis has to be done for it to be applicable effectively.

The organic component in the solid waste in Kathmandu comprise of more than 50%. It includes higher amount of moisture content. Hence, the feasibility for incineration should also be assessed. Also, the approach to sustainable solid waste management in terms of re-use of fly ash does not seem to be viable in the context of Kathmandu as it requires more dry fraction of waste. The literature also reveals that the concept of reduction of solid waste at the first place is very effective strategy and hence that also could be adopted for Kathmandu valley.

10. Conclusion

Kathmandu being developing country, deals with the financial problems that gets reflected in the poor solid waste management system that is prevailing in the city. Thus, the approach for dealing with municipal solid waste sustainably which also admits the cost analysis basis should be adopted. The feasibility of the approaches should be properly examined before implementing to the specific city. Thus, for the Kathmandu city, composting, 3R's concept to reduce the waste at the source and use of RFID enhanced PAYT system seems to be most suitable approach.

11. Recommendations

- Management authority should be active in implementing the laws and regulations effectively.
- Incentive to the individuals who practice recycling should be promoted.
- The end use of composting should have proper users.
- Reward giving system should be promoted who practice recycling process.

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Eco city: Dimensions and its reality in context to Kathmandu

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Abstract

In urban settlements, the concentration of people and their activities create intensified demands on the environment. Urban sprawl is a major problem which creates unnecessary land consumption, habitat fragmentation and loss of natural resources. This directly affects the environmental, social and economic aspects of the cities. A level of sustainable existence has to be reached at which the community can live in a symbiotic cooperative mutual interdependent harmony between design, microclimate, and its environment. The objective of this article is to understand the theoretical aspects of a sustainable city focusing on eco city and analyze the existence of the elements of eco city in Kathmandu valley, focusing on a traditional settlement of Kirtipur. The limitation of this article is based on literature review of the related journal articles and their qualitative analysis. The article analyses the potential of Kathmandu valley to be an eco city in the future, in reference to the sustainability indicators and related case studies. This article may be useful to all the stakeholders involved in the analysis and developing of a sustainable city especially the eco city.

Keywords: Sustainable Development, Urban Form, Eco city, Sustainability Indicators, Kathmandu Valley, Kirtipur

Introduction

The term "Sustainable Development" was first used by the World Commission on Environment and Development (WCED) in its report "Our Common Future", which defines sustainable development as "which meets the needs of the present without compromising the ability of future generations to meet their own needs." This statement has proven to be true because the urban cities are facing the problem of rapid urbanization. The entire Kathmandu valley is evident which is justifiable due to the challenges we are facing in ecological, social, economic, cultural, political, institutional, and most importantly the environmental aspects. Urban form is a composition of characteristics related to land use pattern, transportation system and urban design. Compactness, sustainable transport, high density, mixed land uses, diversity, passive solar design and greening are the seven parameters which led to sustainable development and the different combinations of these parameters develop four distinguished urban forms which are Neo-traditional Development, Urban Containment, Compact City, and The Eco-City. (Jabareen, 2006).

Eco city is considered as an umbrella metaphor of sustainability with distinctive concepts of greening, passive solar design, and sustainable transport (Kenworthy, 2006). The concept of eco city has been propagated by Richard Register, the founding president of Urban Ecology in the year (Singh, 2015). Many of the neo-traditional town planning such as the traditional cities of Kathmandu valley have some elements of sustainability and exemplify the related strategies for new urbanism. The traditional settlements like Kirtipur has compactness, mixed land use and intensification by proper land use for high density which has minimized length of trips and that has the potential to develop non-motorized sustainable transport reducing greenhouse. The parameters of sustainable urban form are correlated to each other and together create social, economic and environmental urban sustainability. “A sense of place, which in itself enhances every human activity that occurs there, and encourages the deposit of a memory trace with the notion of edge, path, node, district and landmark.” (Lynch, 1960).

Four journal articles published in national and international journals have been studied and reviewed. The need and importance of sustainable development has been apprehended, in reference to the article “Sustainable Urban Form” by Jabaaren Y R. Focusing on eco city as one of the distinguishable urban form of sustainable development, its elements have been analyzed in a conceptual model focusing on the relationship between transport and urban form, in reference to the article "The eco-city: ten key transport and planning dimensions for sustainable city development" by Kenworthy J R. The existence of these elements in the traditional cities of Kathmandu valley has been analysed in reference to the article "Ecocity elements in the traditional settlement Kirtipur of Kathmandu valley" by Singh S. Similarly, the indicators of sustainable development for urban cities like Kathmandu valley have been apprehended in reference to the article "Towards Developing Indicators of Environmental Sustainability for Kathmandu, Nepal" by Dr Adhikari A P, which provide reference to policy makers and urban planners to prepare suitable sustainable plans and policies.

Relevance and Importance of Study

One-third of the world's population lived in cities in the year 1950, which today has reached more than one-half, and is expected to reach more than two-thirds in 2050. In the present situation, most of the cities are facing the problems created by rapid urbanization. The environmental quality is on a rapid decline which is affecting ecological balance and quality of environment due to land consumption, habitat fragmentation, and replacement of natural cover with impervious surfaces. Moreover, the resulting urban sprawl affects travel behavior, with heavy use of automobiles which have greenhouse gas emission affecting the air quality and global climate; premature loss of farmland, wetlands, and open space; and noise pollution. Greenhouse gas concentrations are also increasing with excessive use of fossil fuels, especially in developed countries like USA.

In Nepal, energy demand is more but the energy supply is less. With the total population of 2.51 million and a total area of approximately 900 square kilometers, the Kathmandu Valley is growing at 4 percent per year, as one of the fastest-growing metropolitan areas in South Asia (Singh, 2015). The environmental quality of the valley is deteriorating rapidly due to increasing air pollution, water pollution and land pollution in the urban areas. Load shedding is one of the major problems we are facing in daily life with everyday black-outs which has given Kathmandu a reputation of a dark city. The generators consume petroleum, which emit high quantity of pollutants, and are unsuitable in an economic sense. Similarly, heavy traffic congestion and the emitted harmful gases is directly affecting the environment and the health and efficiency of habitants. Recent earthquake has affected the city with much destruction of buildings and infrastructures. It is a high time to act upon these issues to revitalize and develop a sustainable Kathmandu valley. Realizing the historic settlements of Kathmandu valley, eco city seems to be best suited for its sustainable development. The entire Kathmandu valley is a single ecological unit, because of the way the water-shed, drainage, agriculture, atmospheric commons, forests and ground water systems are naturally configured and inter-related. Accordingly, it is best to plan and manage the valley's environment as a single unit (Adhikari, 2012).

Findings and Discussion

In most definitions, the concept of sustainability includes three dimensions: environmental, social and economic and lately, the cultural, ethical, and philosophical elements have also been considered as integral parts of sustainability. Kenworthy in his article 'The eco-city: ten key transport and planning dimensions for sustainable city development' justifies that an eco city is an urban sustainable form, with the distinguishable characteristics of greening, passive solar design and non-motorized transport. In overall, it comprise of the following element of sustainable development.

- Compact urban form with mixed land use
- Well-defined high density
- Human-oriented centers,
- Non-motorized transport
- Greening with Protection of the city's natural areas and food-producing capacity.
- Passive Solar design
- Economic performance and Employment creation
- Environmental technologies for water, energy and waste management
- Enduring physical infrastructure and urban design
- Planning for future city as 'debate and decide' process rather than 'predict and provide' process
- Democratic, inclusive, empowering and hope engendering decision making process.

Moreover, the urban form 'eco city' is very closely related to another urban form 'urban containment' and ‘compact city’ as urban sprawl has to be minimized to develop an eco city. And the urban form of ‘Neo-Traditional Development’ justifies this aspect. So it is clear that the parameters of the four urban forms are compatible and not mutually exclusive, with some distinctive concepts and key differences.

When we look upon the article ‘Sustainable Urban Forms’ by Jabareen Y R, it is clear that before Register, the term Eco city was not new to urban planning and is based on a number of earlier spatial planning models starting from Garden city of Ebenezer Howard. Sustainable urban form and transport are at the core of developing an eco city (Kenworthy, 2006). Unlike in other urban sustainable models, eco city should prioritize to the development of non-motorized transport system with well-designed pedestrian and cycling routes. This creates safer streets, less energy use and less environmental impact. This is justifiable for Kathmandu Valley too as one of the major environmental issue we face each day in our life is the pollution of automobiles and traffic congestion. When we look upon the traditional settlement of Kathmandu valley like Kirtipur, they seem to have maintained the elements of eco city consciously or unconsciously with healthier natural ecosystem in comparison to the contemporary big cities. With a total area of 14.76 sq.km, total population of 65,032 and with the total 19 wards, only five wards are urban in character and the rest are still rural with its population depending on agriculture for livelihood (Singh, 2015). Kirtipur is a culture driven society with an ethnic composition especially of newars. Some elements of eco city can be seen in Kirtipur.

Compact settlement and well defined high density: The land use pattern of core area is based on their culture and is guided by the position of religious heritage. The residential forms are in a confined boundary with row housings enclosing courtyards, and within a network of streets and open spaces. The limits of urban sprawl which were generally done by placing the religious elements like astamatrikas (the gods), the narayans etc. along the periphery (Singh, 2015).

Eco friendly built environment: The courtyards and the slope roof in residences allow penetration of natural sunlight and ventilation to the built environment. The use of brick, mud mortar and timber contribute towards the thermal efficiency of the residences. The bricks used in walls and the tiles used in slope roof are water absorbing.

Human oriented centres: Open spaces like *patis*, *sattals* and temple squares which are for social interaction and community activities, can be found in the street junctions and around temples. The open spaces are also used for bathing, washing clothes, oil massaging and even sunbathing the new born infants.

Greenery with protection of the city’s natural areas and food-producing capacity: When we look outside the core area of Kirtipur, the establishment of the Tribhuwan University and the existence of Taudaha have been major influencing factors in the perseverance of greenery and biodiversity. The core area of Kirtipur lies on the tar land located on higher plateau with boundaries leaving the surrounding fertile land for agriculture and forests in the outskirts, mostly towards the Southern part towards Machegaun, Champadevi Hill and Chovar. Different species of birds can be seen in the Chovar and Jalbinayak area.

Mixed land use: Near to the university, other institutions like Planetarium, Ayurvedic Hospital and Horticulture Research Centre have been established in the recent years which are in close proximity to the core residential area. Small cottage industries and food processing mills are also nearby.

Non-motorized transport: Though the streets are not non-motorized, the density of traffic is very low in comparison to the contemporary cities. During festivals, the chariots of Gods travel around the major routes of the city. So the streets are narrow and pedestrian friendly.

Environmental technologies for water, energy and waste management: Water supply and sanitation system are closely linked to the socio-cultural aspects. Cleanliness was considered next to godliness and water bodies were considered holy (Singh, 2015). Aquifier is recharged to maintain the water balance and supply clean water. There are still ten numbers of ponds mostly located in the core area of Kirtipur. Taudaha is also one of the water bodies that have great ecological significance, bio diversity and is important for ground water recharge. Similarly, the open jointed brick pavement in streets is good for water discharge.

In the present context, the elements eco city in the traditional cities of Kathmandu seem to be depleting due to the changing lifestyle, lack of public awareness and lack of fund for maintenance. In case of Kirtipur, Tribhuwan University which had been a major influencing factor in the maintenance of ecosystem, today is the major factor for the growth of settlements, especially towards the South (Singh, 2015). People are mostly moving to urban periphery leading to urban sprawl towards Nayabazar, Nagaun and Panga, reducing the agricultural land. The construction of Ring road in 1978 has made Kirtipur more accessible to people not only from outside Kirtipur, but also from outside Kathmandu Valley. Slowly the green periphery towards Chovar and Machhengaun are being encroached by new constructions. In Kirtipur, some ponds especially towards the south like the labha pukhu, khasi pukhu, bhin pukhu, mabhin pukhu etc have gone dry and are at risk of being encroached for other purposes.

Following are the key indicators of environmental sustainability for urban cities of developing countries, like Kathmandu valley, which provide reference to policy makers and urban planners to prepare suitable sustainable plans and policies. (Adhikari, 2012)

- Relevance to the local conditions
- Imbedded in Social Vision
- Easy to Measure and Compare
- Helpful to devise policy
- Supporting the community to become proactive
- Reliability of Information and based on available information and data

Conclusion

The current trend of urbanization creates an environmentally, socially and economically unsustainable city. Planners and policy makers have to propose suitable plans that are acceptable for the community. The parameters suggested by Jabareen in his article mostly imply in all forms and may differ according to the physical, socio-cultural and economic aspect (Jabareen, 2006). Ecological and socio-cultural aspect of Kirtipur justifies that the city's tranquil streets not only takes to a different socio-cultural environment, but helps to explore a glorious dimension of human civilization. Present exploitation to the cities due to unplanned urban development, massive migration, exploitation of natural resources, and aggressive promotion of motorized vehicles. The definition of eco city may vary according to researcher and according to the physical, socio-cultural, and economic aspects of country. The planners, policy makers and related fraternity should timely analyze the sustainable aspect of the place with authentic data. If top down approach is not effective, bottom up approach shall be used, where companies like 'Smart Pani' should be encouraged. Eco-city cannot be a forced development, where community sentiment and their needs should be analyzed, through public interaction programs.

"As long as there is nature with its five basic elements water, air, fire, earth and sky are kept in balance, human beings can thrive on earth but the imbalance in nature might lead to its destruction; for as long as there are trees and greenery there is good oxygen in the air; and if trees cannot survive then neither will the human beings. Hence the importance of natural ecosystem cannot be ignored while planning urban settlements and there has to be a paradigm shift in the way urban entities are perceived in the coming days." (Singh, 2015)

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Elements of Energy Efficient Buildings and Adaptive Strategies

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Abstract This paper presents some ideas of creating energy efficient building envelope and reduction in building energy use by application of adaptive comfort principle. Nowadays, energy conservation in buildings is especially important for countries where high energy consumption in residential and tertiary sectors causes the high energy intensity of the whole economy. A Well-designed energy efficient building maintains the best environment for human habitation while minimising the cost of energy. The energy efficient buildings are to improve the comfort levels of the occupants and reduce energy use (electricity, natural gas, etc) for heating, cooling and lighting. In this paper various elements of energy efficient buildings are discussed and also emphasis is given to design considerations for sustainable buildings in order to realize energy saving potentials of the adaptive model in practice.

Key words: Energy efficiency, Thermal comfort, Adaptation

1. INTRODUCTION

Buildings consume a lot of energy all around the world and are responsible for high environmental pollution. Buildings represent 32% of total final energy consumption (IEA, 2016).Developing energy efficiency solutions in order to conduct knowledge-driven sustainable building construction and operation has been a prime need. Major portion of building energy is spend on maintaining thermal comfort. Therefore proper consideration is required while providing thermal envelope. A thermal envelope is everything about the house that serves to shield the living space from the outdoors. It includes the wall and roof assemblies, insulation, air/vapor retarders, windows etc. While design costs, options, and styles vary, most energy-efficient homes have some basic elements in common: a well-constructed and tightly sealed thermal envelope; controlled ventilation; properly sized, high-efficiency heating and cooling systems; and energy-efficient doors, windows, and appliances.

The adaptive approach is based on the overall perceptions and resulting behavior of the Occupants in achieving an adequate level of thermal comfort. The occupants decide an acceptable thermal comfort range by adapting to the internal environment of the building. This minimizes the energy usage and running costs of the building, thus enhancing its economic, environmental and sustainable performance. This paper focuses design considerations for sustainable buildings in order to realize energy saving potentials of the adaptive model in practice.

2. OBJECTIVES

- To explore various elements of energy efficient building
- To analyze various adaptive comfort models

3. METHODOLOGY

An extensive review of the scientific articles has been conducted related to energy efficiency, thermal comfort, sustainability and adaptive principles. Case studies on thermal comfort and adaptive models were compared to generalize the adaptive strategies and energy efficient techniques. By analyzing those articles case studies factors and methods affect the energy consumption in buildings are highlighted. Energy efficiency strategies employed are introduced. The factors, methods and strategies have been analyzed into different phases. Finally, an integrated approach to achieve energy efficiency in building through the suggested phases is proposed.

4. ANALYSIS

The fundamental assumption of the adaptive approach is expressed by the adaptive principle that stipulates "If a change occurs such as to produce discomfort, people react in ways which tends to restore their comfort" (Humphreys & Nicol, 1998). This principle codifies the behavior of building occupants which takes following forms:

- Adjustment to the optimal comfort temperature by changing clothes, activity, postures, using drinks, etc. so that the occupants are comfortable in prevailing conditions.
- Adjustment of indoor conditions by the use of controls such as windows, blinds, fans and also mechanical heating and cooling system.

Insulation

An energy-efficient house has much higher insulation R-values than required by most local building codes. An R-value is the ability of a material to resist heat transfer, and the lower the value, the faster the heat loss. Foundation walls and slabs should be as well insulated as the living space walls. Poorly insulated foundations have a negative impact on home energy use and com-fort, especially if the family uses the lower part of the house as living space.

Window

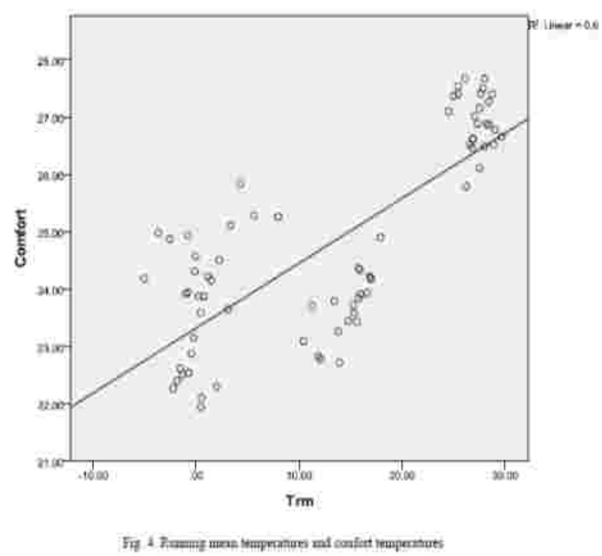
The typical home loses more than 25 per-cent of its heat through windows. Even modern windows insulate less than a wall. Therefore, an energy-efficient house in a heating-dominated climate should, in general, have few windows on its northern, eastern, and western sides. Total window area should also not exceed 8 to 9 percent of the floor area for those rooms. If this is the case, then increasing window area on the southern side of the house to about 12 percent of the floor area is recommended. This is often called solar tempering.

Energy efficient appliances

Appliances with relatively high operating efficiencies are usually more expensive to purchase. However, higher efficiency appliances provide a measure of insurance against increases in energy prices, emit less air pollution, and are attractive selling points when the home is resold.

Adaptive Approach

Thermal comfort by definition refers to condition of mind which expresses satisfaction with thermal environment. There is a clear relationship between comfort temperature and external conditions. As the outdoor temperatures increase, so does indoor comfort temperature. This is an evidence of occupants' adaptation to changing environments. Most of the survey has verified that the comfort temperature is very closely related to the mean outdoor temperature. It is subsequently found that in free running building the optimum comfort temperature is a linear function of the outdoor temperature and may be predicted from the mean outdoor temperature. So the comfort zone temperature should be suitably determined and accordingly optimum use of energy should be done.



Source: (Geun & Jeong, 2014)

Adaptive comfort model, which is obtained from statistical analysis of the monitoring data is given in equation:

Tcn = 0.113* Trm+23.323 (Geun & Jeong, 2014)

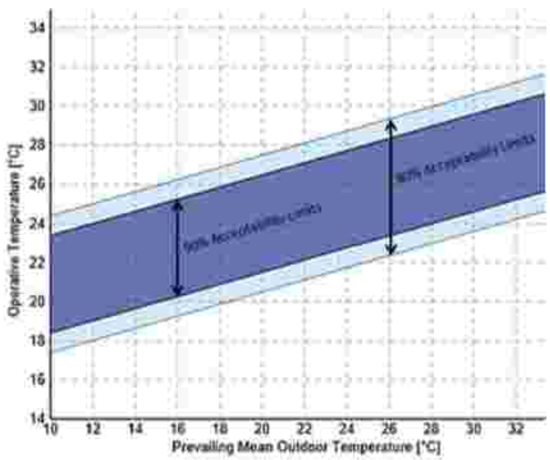
Trm = running mean temperature

Also for another study region with different local climate, adaptive comfort model is given by equation:

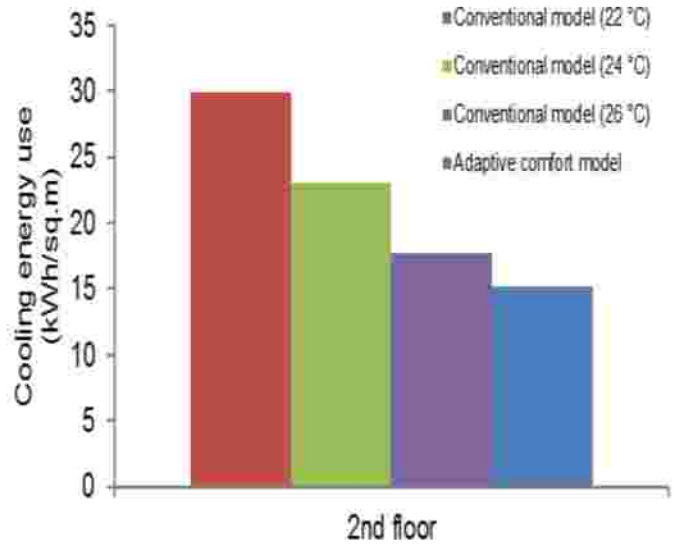
Tc =17.8+0.31*To (Albatayneh, Alterman, Page, & Moghtaderi, 2016)

To= monthly mean of outdoor air temperature

90% acceptability limit = Tc ± 2.5°C
80% acceptability limit = Tc ±3.5°C



Source: (Albatayneh, Alterman, Page, & Moghtaderi, 2016)



Source: (Geun & Jeong, 2014)

These adaptive comfort model have different values of constants in linear equation but they are varying with respect to the mean outdoor temperature. The research indicates that the application of the adaptive comfort model has a high potential for reducing energy use. The mechanical system should be used according to our adaptive behavior and adaptive comfort model in order to optimize energy use and our comfort zone. Also occupants can control thermal environment by clothing behavior, window use, drinking water, drinks, use of sun shades without resorting to mechanical heating/cooling energy.

DISCUSSION AND CONCLUSION

Energy efficiency measures are focused on improvement of buildings envelopes to reduce heat needs for space heating. The main reasons for high heat energy consumption in residential buildings are the following factors:

- Poor thermal quality of a building envelope: walls, insulation, windows;
- Poor standard of ventilation (high losses, oversized systems, no heat recovery);
- Inefficient heat distribution systems inside buildings;
- Lack of control equipment of the space heat and hot water use;
- Lack of Demand Side Management (DSM) methods and energy efficiency awareness.

To improve the energy efficiency in buildings in residential sector the following methods can be employed:

- Improvement of thermal characteristics of building envelopes (including basement), to reduce heat demand for space heating;
- Modernization of heat distribution systems and heat exchange stations: introduction automatic control system, applying of

heat metering, to reduce heat supplied to buildings and heat distributed inside buildings;

- insulation of building envelope
- use of energy efficient appliances.
- change in users behavior and applying adaptive comfort principles

Fundamental role of the building is to provide comfortable indoor environment protecting occupants from harsh external environment. In the past houses were designed considering local climate and material which serves for occupants comfort and environmental sustainability. But after industrial revolution and introduction of mechanical system for energy use building designs are mostly based on artificial energy supply neglecting sustainable approach. This has result in energy crisis and other several socio-cultural, economic and environmental impacts. Thus there should be consideration of energy efficient sustainable building design that provides users with good adaptive opportunity.

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Achieving Sustainable Agricultural Planning And Practices Through Regional Scale Interventions

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Abstract: The modern day demand for agricultural product has resulted into many severs consequences leading to unsustainable practices in agriculture. The ever-increasing demand of energy input in agricultural production needs to be carefully fulfilled to attain energy, environmental and economical balances. There have been many researches and studies in the area for way finding of sustainable agricultural planning. The regional scale interventions in agricultural planning and practices through efficient energy use, and agro based energy sources to economical viability of the crop through suitability analysis are proposed as measures to attain sustainable agricultural planning and practices. The core of the article based on the research objectives and conceptualizations done by three journal articles tries to summarize them into single comprehensive regional interventions which are to analyze the current agricultural practices according to their input characteristics to benchmark the most efficient, analyze the suitability index of the major crops based on soil characteristics and crops requirements and to construct an agro-energy supply chain to fulfill the energy demand of the benchmarked agricultural practice through highly suitable energy crop. Finally the testing of the proposed interventions based on the three criteria energy balance, economical balance, and environmental impact to analyze its sustainability index is proposed. The proposed regional intervention could be powerful measure to attain sustainable agricultural planning and practices.

Key words: Sustainable Agriculture, Agro-energy, Land suitability, Agricultural Planning

Introduction

With the continuously growing global demand for agricultural products and increasing agricultural intensification in most of the areas, development of sustainable agricultural practices is current need. Fundamental changes in the way societies produce and consume are indispensable for achieving global sustainable development. All countries should promote sustainable consumption and production patterns. (Ehrenfeld, 2008) In many of the developed countries, the agricultural intensification has led to many severe consequences such as soil erosion and compaction, nutrient leaching, pesticide spreading and biodiversity loss. And the growing demand of energy, water, nutrients and land area solicit innovative strategies to fulfill them while maintaining the energy, environmental and economical balances. (Ginaldi, Danuso, Rosa, Rocca, Bashanova, & Sossai, 2012).

With an objective of achieving sustainable agricultural planning and practices this article based on three journal articles from three different countries namely India (Khan & Khan, 2014), Germany (Mwambo & Fürst, 2014) and Italy (Ginaldi, Danuso, Rosa, Rocca, Bashanova, & Sossai, 2012) from three different continents tries to summarize the measures conceptualized by them in single comprehensive regional interventions. First article analyses land suitability for major crops according to soil characteristics and crop requirement, second article tries to look into the energy aspect of the agricultural systems and conceptualize an energy efficiency-assessing framework and the third article simulates maze crop as Agro-Energy Supply Chain (AESC) and analyzes economical, energy balances to determine (ACSI, Agro-energy Chain Sustainability Index).

Land Suitability Analysis

Land suitability analysis is the analysis done to find out the suitable land areas for determined potential crops based on the soil characteristics, climatic conditions, land profile and the crop's requirements. The major objective of this analysis is to find out the best potential crop in the region and formulate policies based on these to improve the yields and their economic, energy and environmental balances. For obtaining the better economic balance the best market value crop is determined while for better energy balance regional scale agro-energy supply chain AESC needs to be envisioned based on the land suitability analysis about which the article talks later in the fourth chapter.

In the referred article published in *International Journal of Scientific and Research Publications, Volume 4, Issue 3, March 2014 ISSN 2250-3153* “Land Suitability Analysis for Sustainable Agricultural Land Use Planning in Bulandshahr District of Uttar Pradesh” by Dr. Mohammad Shah Nawaz Khan and Prof. Mohd. Mazhar Ali Khan from Department of Geography, Jamia Millia Islamia, New Delhi, carries out the land suitability analysis for nine major crops in Bulandshahr district. The district lies in UP state of India beside Ganga River with 82.40% gross cropped area. The study area is characterized by six soil series according to its physio-chemical properties, Ganga Khadar Soil Series, Manpur Soil Series, Senta Soil Series, Kota Soil Series, Aulera Soil Series and Ajeetpur Soil Series which were analyzed with data about the production and acreage for the year 2007-08 from district Sankhiyiki Patrika and soil series data from the soil report of National Informatics Centre (NIC). The requirements for each crop obtained from National Bureau of Soil Survey and Land Use planning (NBSS & LUP) and Indian Council of Agricultural Research (ICAR) are used and mapping is done in GIS environment using Arc GIS 9.3. Chemical properties of soil pH (negative log of hydrogen ion concentration), CEC (cat ion exchange capacity), EC (electrical conductivity)

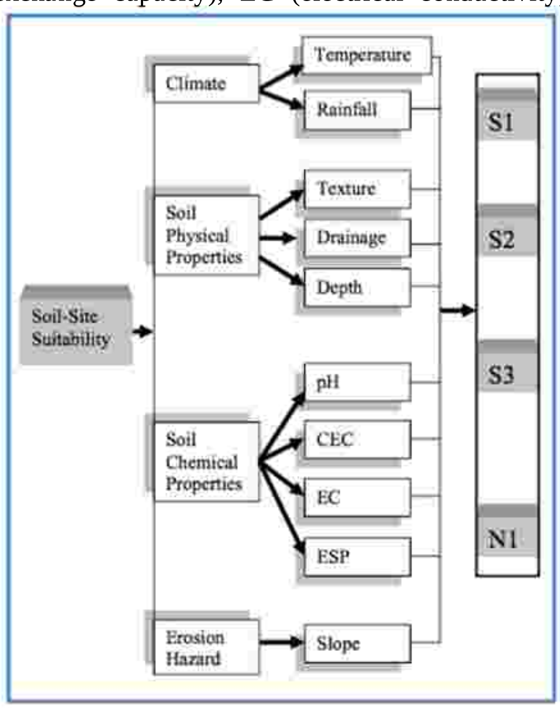

Figure 1 Soil suitability analysis framework (Khan & Khan, 2014)

and ESP (exchangeable sodium percentage) are taken into account along with climatic data of precipitation and temperature, soil physical properties and topographical data. The researchers use land suitability classification method proposed by FAO (1976) with four land categories. ‘S1’ highly suitable, ‘S2’ moderately suitable, ‘S3’ marginally suitable, and ‘N1’ almost unsuitable.

The framework used in the suitability analysis uses four major components of data, climatic data, soil physical properties data, soil chemical properties, and the topographical data. Obtaining these data for a regional scale can be further distributed into different subzones of the region based on administrative zoning so that the output is categorized into administrative subzones and hence the policy formulation and implementations are effective.

Energy Efficiency Analysis

As the energy use in the agricultural sector has been increasing and there have been many changes is the agricultural practices which are energy intensive, the agricultural systems present in the region needs to be analyzed and the energy efficient agricultural systems need to be benchmarked. The proposed energy efficiency analysis is only up to the output yield collection. The later processing and final product generations are not included in the analysis.

With the continuously growing global demand for agricultural products and increasing agricultural intensification in most of the areas, development of sustainable agricultural practices is current need. The referred article “A framework for assessing the energy efficiency of non-mechanized agricultural systems in developing countries”? published in *Proceedings of the 28th EnviroInfo 2014 Conference, Oldenburg, Germany September 10-12, 2014* by Francis Molua Mwambo supervised by Christine Fürst from Center for Development Research (ZEF), University of Bonn, tries to conceptualize an energy efficiency analysis framework for non-mechanized agricultural systems in developing countries from Africa. The article divided into four sections has first two sections are more introductory. Referring to many reports and articles it builds up the necessity of an universal energy efficiency analysis framework by showing short-comings of the current frameworks which fail to address different scales in decision making, i.e. connecting the management planning level with regional development considerations properly. The methodological framework conceived in the third section is a combination of different concepts to look at non-mechanized agricultural systems. It is mainly based on the EMergy calculation for the various energy inputs, natural and artificial further categorized into renewable and non-renewable, in the production process. Which sum up for the unit output. These energy values including their corresponding land-use schemes are fed into the Data Envelopment Analysis (DEA) model to benchmark the optimal efficient land-use scheme. The non-parametric statistical analysis by Data Envelopment Analysis takes into account the land-use schemes as the decision-making units (DMUs). Different data on meteorology, human labor, animal draft, purchased implementations and yield per land use area are fed to DEA as secondary data.

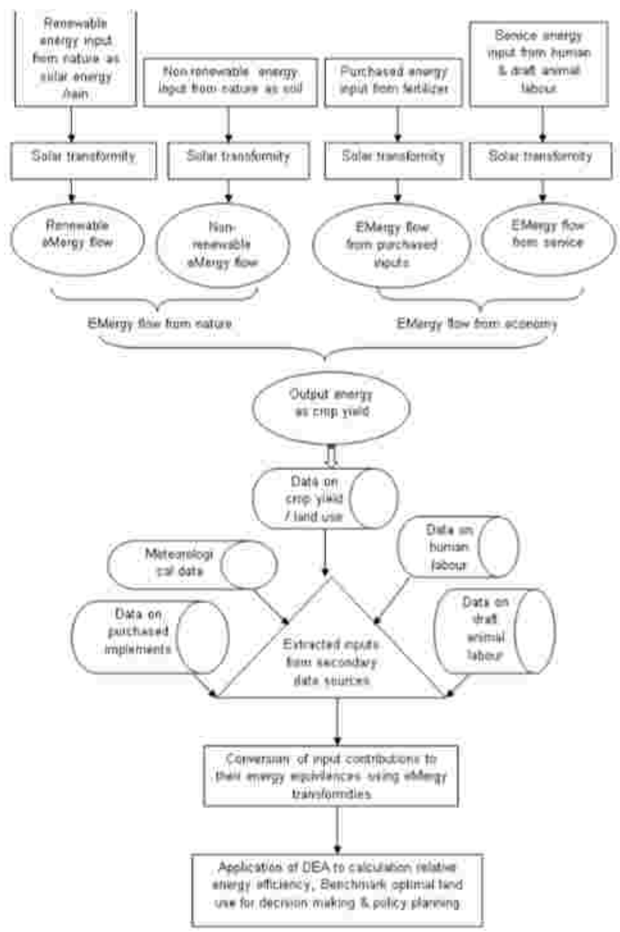

Figure 2 Framework for Energy efficiency analysis (Mwambo & Fürst, 2014)

Agro-Energy Supply Chain

As the growing energy demand in agriculture solicits innovative strategies to fulfill them, the self-sustaining energy source from the agro based energy sources has been the recent area of study by many researchers. The use of agricultural bi-products as sources of energy has been practiced for long time, though the conversion of energy-crops to yield biofuel likes ethanol, biogas, charcoal etc. have been more of a concern in the present scenario. There are many biofuel-processing projects being carried out around the world. (IEA, 2007) Bioethanol is the most common biofuel, accounting for more than 90% of total biofuel usage. Conventional production is a well-known process based on enzymatic conversion of starchy biomass into sugars, and/or fermentation of 6-carbon sugars with final distillation of ethanol to fuel grade. Ethanol can be produced from many feedstock, including cereal crops, corn (maize), sugar cane, sugar beets, potatoes, sorghum, and cassava. Co-products (e.g. animal feed) help reduce production cost. (IEA, 2007)

Though the selection of energy crop can be done based on the suitability analysis and the energy efficiency analysis of their production, which is later, fed to the analysis model referred from the research article **“Agro-energy supply chain planning: a procedure to evaluate economic, energy and environmental sustainability”** published in *Italian Journal of Agronomy 2012; volume 7:e31* by Fabrizio Ginaldi, Francesco Danuso, Franco Rosa, Alvaro Rocca, Oxana Bashanova and Emiliano Sossai from University of Udine. This research evaluates the potential supply of energy from energy crop in the plain of Friuli Venezia Giulia (FVG) a region situated in the northeastern part of Italy covering about 161,300 ha, this research article proposes an agro-energy supply chain approach at regional level by simulating maize crop yields on modular-structured miniCSS. For achieving a sustainable Agro- energy supply chain (AESC) the researchers set three main goals of energy market security, minimal environmental impact and avoiding social consequences of energy shortages. The research is conducted analyzing economic, energy and environmental indicators of the AECS at three different agronomic treatments. The main purposes of the research are summarized in three points, to analyze the effects of pedoclimatic events, to optimize the biomass hauling by assuming a cooperative organization and to optimize the performance of AESC by analyzing simultaneous balances based on economy, energy and environmental impact.

Similar simulation of the potential energy crops and their efficiency analysis would lead to the selection of the optimal Agro-Energy Supply Chain AESC. Further analysis of the optimal collection point distribution, processing plants location and the organization model of the AESC would be the foundation of policy making and planning for Sustainable Agriculture.

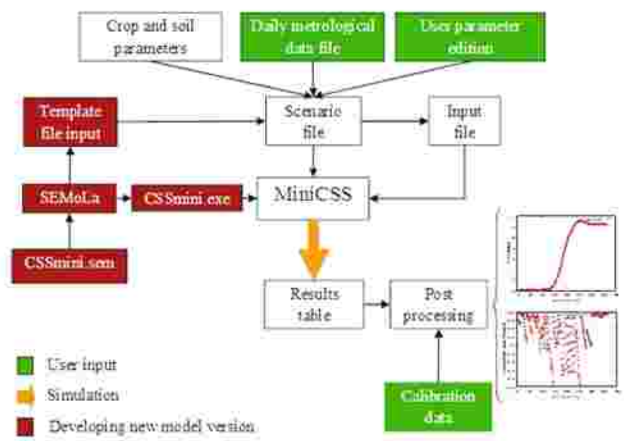

Figure 3 Crop simulation framework using miniCSS (Department of Agriculture and Environmental Science, 2005)

Comprehensive Interventions for Sustainable Agriculture

The comprehensive regional interventions are to analyze the current agricultural practices according to their input characteristics to benchmark the most efficient, analyze the suitability index of the major crops based on soil characteristics and crops requirements and to construct an agro-energy supply chain to fulfill the energy demand of the benchmarked agricultural practice through highly suitable energy crop. Finally the testing of the proposed interventions based on the three criteria energy balance, economical balance, and environmental impact to analyze their sustainability index is proposed. The proposed regional intervention could be powerful measure to attain sustainable agricultural planning and practices.

Conclusion

For achieving a sustainable development, sustainable agricultural planning plays very important role and for many developing nations it is vital component. Since agriculture is the producer and user of the energy, environmental resources and the economy at the same time, carefully planned strategies to meet the requirements of sustainable agricultural development are very important. Many interventions to check the present unsustainable agricultural practices and planning policies to strategically reach sustainable future of our agriculture have been felt many times. The regional level planning and policy interventions, which propose to evaluate the energy efficiency of the current practices and benchmarks, the optimal agricultural system can be fruitful to do so. The formulation of agricultural land use policy based on land suitability analysis and establishment of Agro-Energy Supply Chain at regional scale are long-term interventions to attain Sustainable Agricultural future. The energy independent Agricultural practices with most efficient energy use and high yields to support future needs should be the aim of the Land use planners and policy makers at rural to urban regional levels.

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Life Cycle Costing (LCC) Analysis of Green Roof

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Abstract: Green roofs possess a variety of merits with only major drawback being the premium investment cost. This paper strive towards justifying the initial investment with a payback period by assessing the life cycle cost of the roof. The maintenance of the green roof also requires some effort which has been incorporated in this paper. The research shows that per square feet cost burden is decreased with the increased area of the green roof.

Keywords: Life Cycle, Green Roof, Sustainability Indicator

Nomenclature

LCC Life Cycle Costing
LCA Life Cycle Assessment
NPV Net Present Value

1. Introduction

Green roofs are considered as a solution to many urban issues including urban heat island mitigation, noise and air pollution reduction, storm-water management and support of biodiversity and are quite often addressed as the best building choice to increase the environmental sustainability in an urban setting. Recent initiative at European level also promote a benefit for those building covered by a green roof as a reduction in Land use impact.

Generally speaking, it is now quite clear that green roofs can be used to reduce or mitigate issues as urban heat island effect, water runoff, air and water quality (Liu et al., 2003; Wong et al., 2003). Most of the reasons that stop building owners in building a green roof lay in the idea that beside the initial costs, cost form maintenance of green roof during the life cycle of the building are quite high. In fact, some studies have demonstrated that intensive or deep soil roof systems have a higher life cycle cost (LCC) than conventional practice, but this is not always true for extensive green roof system that might cost less than a conventional roof. (Gargari, Gargari, Fantozzi, & Campiotti, 2016)

Moreover, considering that the European Regulation on Energy Efficiency 31/2010 drives to nearly zero energy building, energy and resources consumption in buildings are in a near future primarily due to the building material. More than the energy consumption in use, the environmental impact of the building materials becomes therefore an urgent performance to be evaluated in a life cycle perspective. Even environmental impacts due to energy consumption during the use phase of the building have been drastically reduced in the last 10 years, the estimation that the use represents approximately 80%

to 90% of the life-cycle energy use, while 10% to 20% is consumed by the material extraction and production, and less than 1% through end-of-life treatments is still not so far from the realty, especially in Mediterranean climate where conventional building dates back to ’50es and ‘60es.

The main goal of the Life Cycle Costing approach is to optimize life cycle costs of the assets or investment project without loss their performance. The scope of investments project is dependent on the company size, its investment planning and financial or other resources. The evaluation of investments is made on the decisive criteria (rate of return, risk, repayment period, etc.) which can be evaluated by several methods. The investment evaluation can be explored from several points of view. We mainly focus on costs or profit but the widely used criterion is Cash Flow (sum of profit after tax and value of depreciation). If the time factor is used or no the methods are divided on static or dynamic tools. E.g. The Net Present Value Method (NPV) is considered to be the most widely used method. (Spickova & Myskova, 2015)

The following chapters describe the comparison of the data divergences which provides financial or managerial accounting. By the majority of fixed assets we showed that their operating costs comprise the largest share of the LCC. This is primarily due to the fact that these costs are associated with the longest stage - using - during their life cycle. In the final part of article we have shown the practical comparison of two investment projects with using LCC and NPV.

2. Methodology

2.1. Accounting Approach of the Economic Life Cycle and Standards

Life cycle costing (LCC) is special kind of accounting which is used in Anglo-Saxon countries as terotechnology. The using of this approach is suitable for project management, control and evaluation of investment projects. The concept is based on the possibility of show all costs and revenues for the concrete investment project include their all items and time demand. The task of LCC is taken into account the all actual costs and revenues associated with some kind of an asset over its economic life-cycle and at the lowest possible total cost. The important information (as how much and which relevant costs were expended in all period of the economic life cycle for the analyzed asset or investment) are collected through LCC.

This paragraph compares the approach of the traditional finance accounting with the concept Life cycle costing which is involved to strategic management accounting. The finance accounting is focused directly on the acquisition prices, depreciation, and asset residual value. These values are collected by using the applicable accounting rules and procedures (GAAP/IFRS/local accounting standards). It is natural that the using of the classical accounting is not suitable for assessment of the actual costs and benefits associated with the asset. The reason is the complexity of investment opportunities. The further different approach is financial accounting - a useful measurement of assets by comparison with the real economic life.

2.2. Asset Cost Breakdown and Economic Life

LCC analysis is based on many costs inputs. More it usually requires much different information for the project life cycle phase costs calculation. Economic life cycle total costs are usually considered with the implementation on the market. LCC analysis includes all costs to be evaluated. Costs usually include the tendered sum (purchase price/investment) and as a minimum the energy cost, but often, also maintenance and other relevant costs that must be defined in the inquiry information. (Spickova & Myskova, 2015)

The relative costs, cost-saving benefits and added value of a green roof versus a black roof over a 50- year timeframe was then accounted for and discounted back to present value. Six separate cash flows were created to allow data segregation and identification of the relative benefits:

- Installation, replacement and maintenance
- Storm water
- Energy

The cash flows from the following benefits were not included in the analysis:

- Urban agriculture
- Acoustics

2.3. **Assumptions**

Users should be aware that the intent of this analysis is to present “average” costs and benefits on a very broad level.

This analysis developed a standardized cost for both intensive and extensive roofs using the federal prevailing wage rates for Washington DC, and current material costs. As demonstrated in Figure 21, extensive green roofs are approximately \$6 to \$8 per square foot cheaper to install than semi-intensive green roofs, and in both cases larger green roofs cost less per square foot to install than smaller green roofs.

Green roof maintenance

The first years of a green roof’s existence are considered an establishment period, in which maintenance is critical to the roof’s long-term success and maintenance requirements are greatest. Maintenance of a green roof includes weeding, harvesting cuttings and distributing them in bare spots to improve coverage, checking for loss of growth medium, and inspecting for other potential problems. Maintenance costs will be higher any time a green roof includes a landscaped design, as workers will also need to spend time maintaining the design aesthetic. A typical maintenance crew includes two workers, though more may be needed for a larger roof. For this study, labor hours were rounded up to the next half-day for cost estimating purposes.

A minimum of three maintenance visits per year is recommended for an extensive green roof during the establishment period. The typical labor requirement is 4 person-hours per 1,000 square feet per year, or 1.33 person-hours per 1,000 square feet per visit. Maintenance requirements will decrease after the establishment period; this analysis assumes a reduction to two visits a year for this type of green roof.

3. **Results**

The results presented below are itemized to show the relative differences in costs and benefits, in an effort to help the reader to understand the relative impacts on the costs and benefits of installing a green roof.

PARTICULARS	Roof Size (ft^2)		
	5,000	**1,0000**	**5,0000**
Initial Premium, \$/ft^2 of roof	-\$12.6	-\$11.4	-\$9.7
NPV of Installation, **Replacement** & **maintenance**, \$/ft^2 of roof	-\$18.2	-\$17.7	-\$17.0
NPV of Storm water, \$/ft^2 of roof (savings from reduced infrastructure improvements and/or strom water fees)	\$14.1	\$13.6	\$13.2
NPV of Energy, \$/ft^2 of roof (energy saving from cooling and heating)	\$6.6	\$6.8	\$8.2
Net Present Value (installation, Maintenance & Replacement + storm water + energy NPV)	\$2.5	\$2.7	\$4.5
Internal Rate of Return	5.0%	5.2%	5.9%
Payback, years	6.4	6.2	5.6

Table 1 Cost Benefit Analysis results of green roof v/s black roof *(GSA, 2011)*

4. Discussion and Conclusion

The added cost of installing a green roof is mostly made up for by its increased longevity; however, the added maintenance costs are significant. Over a 50year period, the stormwater, energy, carbon dioxide equivalent (CO2e, which measures the potential global warming effect of a greenhouse gas) and community earnings of green roofs more than made up for the increased premium of installing and maintaining them.

Although building and site characteristics, stormwater regulations and energy costs vary greatly, long-term savings of green roofs help make up for their maintenance costs. The fewer floors a building has, the greater the energy savings will be. The greater the surface area of a green roof as a proportion of the overall site surface area, the greater the stormwater management savings will be. These savings are expected to increase as stormwater regulations become more stringent and green roofs are increasingly viewed as an acceptable stormwater mitigation measure.

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Sustainable Building Materials

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***Abstract*: The desire for building houses is booming in Nepal in this post earthquake phase. People want to move from temporary shelter to their permanent house as soon as possible. Different organizations from different countries have extended their helping hands in every possible way. Be it technical assistance or financial aid. Hence this phase can prove a great opportunity through sustainable approach. One of way to make greener, environmentally sustainable, more energy efficient Nepal can be application of sustainable building materials. Sustainable building materials include structure, infill panels, furnishing and fittings and a whole system in case of machines and plumbing. No materials can be 100% sustainable but the degree of sustainability can be increased through improvements in various phases: Pre-building phase, Building phase and Post-building phase. Small ameliorations can bring significant changes in GHG emissions reduction, waste and pollution reduction, lower embodied energy, health and environment. For the measurement of the sustainability different software has been developed. Even the commercial sector has started distributing energy star, green labeled products in the global context. Nepal is far behind in this sector as there are plenty of challenges like ignorance of people, gaps in policies of government, lack of knowledge about indigenous and traditional materials among the technical groups. Despite all these challenges, few projects have been launched catering the people, sustainability and present demands. Understanding the examples going around the world, Nepal can also get benefitted with similar, contextualized and updated approaches.**

Key words: Sustainability, Material life-cycle, GHG &CO_2 emission, Embodied energy, Economic &Environmental costs

1. INTRODUCTION:

Building has huge impact in environment. According to UNEP (Sustainable Buildings and Climate Intiative, nd), buildings use about 40% of global energy, 25% of global water, 40% of global resources, and they emit approximately 1/3 of GHG emissions. It also adds that buildings also offer the greatest potential for achieving significant GHG emissions reductions, at least cost, in developed and developing countries. Furthermore, energy consumption in building can be reduced by 30 to 80% using proven and commercially available technologies. For developing country, new green construction yields enormous opportunities. Population growth, prosperity and increasing urbanization fuel building and construction activities. In Nepal, recent earthquake of 2015 destroyed 2,02,157 houses fully and forced victim families to settle into the temporary shelter (Nepal Disaster Risk Reduction Portal, 2015). Hence, it requires fast paced reconstruction of both private residences, and public monuments. Nepal has huge financial viability with significant remittances, foreign donations and aids for reconstruction. But there is huge question in terms of safety of environment and its resources in the name of reconstruction. Concerns are to be given by the policy makers, building experts, local bodies and local inhabitants for optimal utilization of environmental resources so that reconstruction does not come at the cost of huge deforestation, environmental pollution and health of people. Concept of sustainable building material can play key role to balance the reconstruction and environment.

Green building materials, environmentally friendly building materials, sustainable building materials, though the names are different but the gist is same. By definition given by David Rousseau, *Environmentally-friendly building materials are those that provide appropriate service and life span, with minimum maintenance, while minimizing the extraction of raw materials, the pollution from, and energy consumed by manufacturing and use, and that have the maximum potential for reuse or resource recovery* (Rousseau, nd). Sustainable building materials may come from the traditional, vernacular architecture such as earth, stone, timber, bamboo, or they may come from improvements of existing industrial processes analyzing life-cycle-analysis, or they may came from new process or raw material inputs such as industrial waste. With an approach of sustainable building material, individual buildings and overall cities can be made sustainable.

2. OBJECTIVES:

The main objective of this article is to introduce sustainable building materials for reconstruction of Nepal after April 25 2015 Earthquake. For that it is foremost to identify the criteria of sustainable building materials, factors for selection. Then after, to evaluate the present building materials in term of sustainability and learn about the possible scope of other sustainable building materials as well.

3. LIMITATION:

This article is an outcome of secondary data only. There was no any kind of field survey made for this. With the help of literature review of some selected articles and other references articles, this article is prepared. Also, the article is limited only as part of the classroom assessment than some research product.

4. LITERATURE REVIEW:

Three articles were read to learn about the sustainable building materials in holistic way.
To contextualize in Nepal, more reference articles has been studied. Those articles are solely taken from the internet access. From those articles certain framework has been developed and elaborated likewise. Following are three articles:

- **Sustainable Building Module**
  Written by
  Jong-Jin Kim, Assistant Professor of Architecture, and Brenda Rigdon, Project Intern
- **Sustainable Building Module**
  Written by
  Jong-Jin Kim, Assistant Professor of Architecture, Brenda Rigdon, Project Intern;
- **Sustainable Building Solutions**
  By Pierre Roux and Alex Alexander
  Anyway solutions

4.1 Phases of materials:

Every material has been evaluated in different phases of life in order to make "cradle to grave" analysis. By this, analysis starts from gathering of raw materials to ultimate disposal. Despite the fact that prime basis of categorizing pre- building, building and post- building phase, for the material life-cycle. One of the inclusive categorization from the 3 selected articles as given in Sustainable Building Module is as follows (Kim & Rigdon, 1998):

A. Manufacturing Process (MP)

a) Waste Reduction (WR)

b) Pollution Prevention (P2)

c) Recycled (RC)

d) Embodied Energy Reduction (EER)

e) Natural Materials (NM)

B. Building Operations (BO)

a) Energy Efficiency (EE)

b) Water Treatment & Conservation (WTC)

c) Non Toxic (NT)

d) Renewable Energy Source (RES)

e) Longer Life (LL)

C. Waste Management. (WM)

a) Biodegradable (B)

b) Recyclable (R)

c) Reusable (RU)

d) Others (O)

4.1.1 Manufacturing process:

This phase has the most potential for causing environmental damage as it includes extraction, processing, packaging, transportation for a complete manufacturing process. Hence, the wise-selection of building materials in this phase can lead to minimal environmental impacts. From procurement method of raw materials, manufacturing process, to distance from manufacturing location to the building site affect a lot in mining process, embodied energy and ecosystem. Disturbance in ecosystem can lead to the loss of wildlife habitat, erosion, and water and air pollution. Selection of materials from environmentally responsible manufacturer encourages their efforts at environmental pollution. Also environmental pollution can be reduced by simply reducing demand, which causes lower production and eventually lower waste. Likewise, the waste reduction can be possible from both architect's side as well as manufacturer side by maintaining size of building as per the size of materials and by powering the operations from the waste products generated on-site respectively. The products that are made up of post-industrial or post-consumer waste partially or entirely are a part of sustainable materials. Because they reduce the waste stream, demand on virgin natural resources reduces and preserve embodied energy. Embodied energy of material refers to the total energy required to produce that material, fuel used to power the manufacturing process and transportation. Embodied energy can be reduced by utilizing natural materials and local materials. But, it is not always possible to use locally available materials. In that case imports can be made but they should be used selectively small a volume as possible. Lastly the use of natural materials over the mined materials is good because the embodied energy of natural materials is lower than the mined materials.

4.1.2 Building Operation:

The second one is building operation where material's useful life is encountered from material's assembly into a structure to maintenance and repair. Use of certain products which outgases hazardous chemical should be replaced or repaired. Likewise, health of construction workers, occupants should be primary concern while selecting the materials. Use of toxic materials, problem of indoor air contamination can cause 'sick building syndrome' and other diseases. Another major factor of sustainable building material is energy efficiency. The ultimate goal in using energy-efficient materials is to reduce the amount of generated energy that must be brought to a building site. Energy efficiency can be measured using factors such as R-value for building envelopes, insulation materials, shading coefficient for the glass types, shading devices and glazing patterns and system efficiency for electrical and mechanical systems. System efficiency can also significant for the treatment and conservation of water, harvesting rain water, utilization of grey water. It is also important to note that sustainable building materials is not limited to the construction materials but it covers those machinery equipments which can utilize the renewable energy (Geo-thermal energy, Wind energy, solar energy) for the well functioning of the building. For instance; solar water heater, solar PV panels etc. On the other hand, life span of the materials should be considered as well. The materials having longer life doesn't need more maintenance, repairing or replacing which obviously means the labor costs for repairing, maintenance and replacing of the materials. Likewise, the consumption of raw materials, waste and pollution production during manufacturing of new one to replace older one can be avoided.

4.1.3 Waste Management:

In waste management, the life of materials after the proper life span is considered. Materials can be reused in its entity, or recycled back or be discarded. Reusability is a function of the age and durability of a material. Windows and doors, plumbing fixtures, and even brick can be successfully reused. Timber from old barns has become fashionable as a reclaimed material for new construction. Recyclability measures a material's capacity to be used as a resource in the creation of new products. Steel is the most commonly recycled building material, in large part because it can be easily separated from construction debris by magnets. Glass is very easy to recycle: post-consumer glass is commonly used as a raw material in making window glass, ceramic tile, and brick. Concrete, unlike steel and glass, cannot be re-formed once set, but it can be ground up and used as aggregate in new concrete or as road bedding. The biodegradability of a material refers to its potential to naturally decompose when discarded. An important consideration is whether the material in question will produce hazardous materials as it decomposes, either alone or in combination with other substances.

4.2 Labeling Of Materials

Labeling of the materials can be done manually, commercially or with the help of software. By following below shown table, we can easily fill up the features of the materials and know the label of sustainability.

MP	BO	WM
WR		
	WTC	R
RC	NT	RU
EER		
	LL	

Figure 1: Green features of plastic lumber & paver

Meanwhile, developed country use the various software for the marking the sustainability of the materials. Some of the software that has been developed around the world are BEES National Institute for Standards and Technology) and ATHENA (Canada, sustainable Materials Institute), LCAiT from Sweden, IDEMAT, Netherlands, GaBi4 from Germany. For the selection of material in the market, one can just simply see the green rating or energy star of the material (Rousseau, nd).

4.3 Scope

4.3.1 Scope in Rural Areas:

There is wide scope of sustainable materials in rural areas where community understanding and co-operation is strongly prevailed. The characteristics of the house of rural houses are that they are small, generally one-two storey, and load bearing structure. The intensive human labor can be utilized for producing sustainable local building materials through in-situ produciton. Such as: recycled materials and bricks made from building rubble, earthbag construction, adobe bricks, stabilized earth blocks, compressed sand bricks and hydraform bricks. Those materials are local and unprocessed building materials with minimal transport costs and manufacturing energy and air pollution. Depending upon the opportunities and weakness of a particular place, selection of materials can be done. For e.g.: Reused and recycled building materials can be used if the demolition site is near to the site (5km). Similarly, sandbag houses can be made where there is plenty of sand. As for instance: Case study of sandbag houses, Mitchell's Plain (Roux & Alexander, ND)where abundance of sand is more than the soil. Also the use of indigenous sustainable materials like adobe bricks, rammed earth can be used. However, those sustainable materials should be verified with respective embodied energy and standard high compressive strength bricks as per the corresponding government rules.

Figure 2: Eco-beam & sandbag construction, SA

4.3.2 Scope in Urban areas:

The buildings of urban areas are more complex than the buildings of rural areas with multi-function, multi-storied and diverse consideration in many components like structure, landscaping, building envelopes etc. Wide range of sustainable materials is available in the market for different components. Since, the society of urban areas are more isolated, elite and industry dependent, the sustainable materials here used are industry processed than human labor. Some of the examples of sustainable materials for urban areas are as follows:

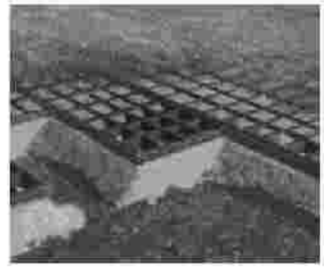

Figure 3: Porous pavement system made from recycled plastic lumber

Site & landscaping	Plastic lumber and pavers
Foundations	Insulated foundations.
Structural Framing	Steel framing
Building envelopes	Straw-based sheathing
Structural envelopes	Bricks and CMU
Insulation	Insulation made from Recycled newspaper
Glazing	Doubled paned glass
Roofing	Fiber-resin composition roofing tiles
Interior Finishes	Sisal wall coverings
Flooring	Integrated Flooring
Plumbing	Vacuum toilet system
ventilation	Energy Recovery ventilators

4.4 Environmental & Economic Costs

The sustainable building materials are tend to be costlier other building materials due to consideration during manufacturing process. However, the first time cost can be compensated through the durability of the materials. The life span and the first time cost of the material can be compared against each other in terms of environmental and economic cost. This particular comparison is represented by a mathematical formula, capitalization rate.

The capitalization rate method works backward from the value placed in a building in term of its market price or rental income potential and determines what it is economic to spend on it, given certain interest rates, profit margins, and depreciation allowances etc. if the market definition if value can shift slightly to encompass durability, environmental qualities and security from future shortages of replacement materials or escalation in disposal and replacements costs, then investments in quality, environmentally friendly materials can be better justified.

-David Rousseau (Rousseau, nd)

During the manufacture of the materials, certain environmental resources are utilized in form of the raw materials, land use or waste production. This can cause habitat disturbance, breakage in ecosystem. But if the life span of the material gives enough time to heal the disturbed habitats, replace the raw materials, absorbs the waste, then the materials can be considered environmental sustainable. On the other hand, the first time cost of the materials should justify the maintenance and repairing charge including labor charge, material charge etc.

4.5 Practices in Nepal:

Various attempts have been made by various organization and government itself for sustainable building practices because GHG, CO_2, environmental pollutants are emitted while manufacturing the building materials. Those harmful emissions are responsible for climate change, environmental pollution causing devastating effect on Nepal like melting of snow in the mountains, untimely rainfall and health hazards. In order to minimize (short-term target), prevent (long-term target) in coming years, various steps should be taken. There are some significant initiatives as well.

4.5.1 Green homes:

Green Homes – the Sustainable Housing is developed by UN-habitat Nepal (UN-Habitat Nepal, ND). It is an approach that includes housing systems which reduce pressure on natural resources and carbon emissions, thus resulting in human wellbeing, social equity, and promotion of green economy. Besides energy efficiency in buildings, it also includes eco-friendly practices for water and waste management systems such as rainwater harvesting, and waste/wastewater recycling. Green homes are more than just green buildings – they reflect a sustainable lifestyle based on eco-friendly systems and behavior. At present, Green homes are preparing to develop at the three major cities; Dharan, Pokhara and Lalitpur

Features of Green Homes:

- Use sustainable and environment friendly building materials
- Energy efficient and comfort design
- Conserve energy and water
- Produce less waste in the process
- Improve indoor air quality

4.5.2 ABARI:

ABARI is a socially and environmentally committed research, design and construction firm that examines, encourages, and celebrates the vernacular architectural tradition of Nepal. As Nepal posses sophisticated traditional knowledge of natural materials like adobes, bamboos, stones and reed, ABARI as a research and design firm that tries to promulgate these materials into contemporary design practices. The main purpose of the company is to find alternate natural building materials for concrete and steel. Instigated by environmental consciousness, health, aesthetic and economic reasons that people are showing-even small-a reinvigorated interest to go back to natural building materials like adobe and bamboo. ABARI is seeing modest institutionalized effort to reinvestigate traditional natural materials so that they can be re-appropriated to cater to the modern requirements in Nepal (ABARI, nd). Some of their works are Madan Puraskar Pustakalaya, Naomi and Narayan Residence etc.

4.5.3 Vertical Shaft Brick Kilns and other Sustainable Practices:

This project is implemented as part of the EU financed SWITCH-Asia Programme to promote Sustainable consumption and Production (SCP) in Asia (Sustainable construction Newsletter, 2013, Issue 1). The main objective of this project is to reduce the energy consumption and CO_2 Emissions from the brick and construction material sectors in urban and semi-urban areas in Nepal. Secondly, the commercial sector for green building production will be mobilized and capacitated. Third, conduction awareness program through marketing events and workshops among the public and inform customers alike about the major benefits and choices of cleaner and low energy building materials.

Vertical shaft Brick Kilns:

This is a clean green brick firing technology that has evolved from the traditional up draught kilns in rural China. The main element of the VSBK is the vertical shaft (of rectangular or square cross-section) in which the brick firing takes place. It is very energy-efficient and has the lowest CO_2 emissions. Since the beginning of 2013 alone, eight new VSBK brick factories had started brick production in various districts with technical support provided by this project.

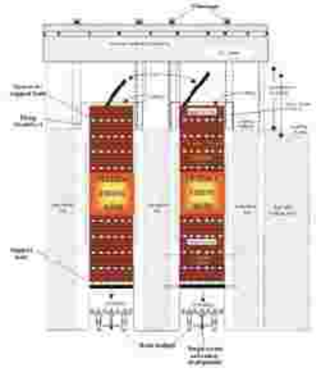

Figure 4: Section of Vertical Shaft Brick Kilns

5. Conclusion:

Growing concerns on environment, energy, health and economic cost have raised the approach of sustainable building materials. Many organizations are working for greener, environmentally sustainable, more energy efficient Nepal. Organizations along with donor agencies and government have started many projects. From providing technical assistance to ready to move in projects has been seen in the field. However, only projects are only continuing due to different other technical reasons. Mobilization of these resources properly and appropriately helps the concept of sustainability flourish. And this reconstruction phase that April 25 2015 earthquake has brought can prove boon to Nepal for developing sustainable city, town and village.

6. Recommendations:

Since Nepal is in its embryonic stage in utilizing sustainable building materials. There are plenty of suggestions that can be made for proper application of the materials.

- Market should be provide the sustainable building materials with certain marks like energy star, green labeling etc to help in selection of the materials from market.
- Government should draft the policies and regulations on sustainable building materials for mandatory use.
- Government should also come up with different scheme like subsidy, incentives for encouraging the use of sustainable building materials. This can cater the lower income group and environmental conscious manufacturers.
- The technical experts should be educated with traditional, indigenous sustainable materials like adobe, earthbag constructions in order to retain the vernacular character of a particular place.
- There should be certain certification as reward and ranks for the buildings which have applied sustainable building materials.
- There should also be standards for inspection of strength, embodied energy of the sustainable materials.
- There should be research centers on our own for research on sustainable building materials rather than coping some developed countries.

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Evaluation of Biogas Production from Digestion of Rice Straw and Market Wastes

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Abstract: The study carried out the evaluation of potential use of rice straw and organic fraction of market wastes to generate biogas by other anaerobic digestion. A set of 1.5 L digesters were used to determine the biogas potential of the biomass and a set of 10 L digesters were used to evaluate the effect of feeding mode. In the case of rice straw, a maximum biogas of 10 L/kg VS was produced on the day 20 at a controlled temperature of 32oC. For market waste, a maximum biogas of 50 L/kg VS was produced for the same period of digestion, which was 60% higher than that at ambient temperature. Digester fed on rice straw with 75% fresh feed replacement produced 42 L/kg VS, higher compared to 50% fresh feed replacement. The digester run at 50% fresh feed addition showed higher rate of biogas generation in the early stage of fermentation and shorter lag phase because of its higher concentration of acclimated sludge. For the case of market waste, digester run with 75% fresh feed resulted in the biogas production of 40 L/kg VS, higher than that run on 50% fresh feed. However, both were lower compared to the control digester that produced 52 L/kg VS.

Keywords: Biogas, Anaerobic digestion, Market wastes, Rice straw, Cow dung

Introduction

In evaluating national development and the standard of living of any nation, the supply and consumption of energy are very important. The overdependence on fossil fuels as primary energy source has led to global climate change, environmental pollution and degradation, thus leading to human health problems. According to current research and future predictions, the crude oil will run out within 40 to 70 years, and natural gas will be finished within 50 years.[1] Biogas is a carbon–neutral source of renewable energy. It presents competitive source energy in terms of energy efficiency and its minimal environmental impact.[2] Abundant quantity of agriculture residual and market wastes are available in our surrounding environment. In most cases, these wastes become burden to environment when treated improperly by burning or being left decomposed without control. The application of anaerobic digestion technology simultaneously converts the organics of biomass into valuable products such as energy in the form of biogas and soil improver in the forms of liquid fertilizer. Energy productions from biomass or organic wastes were considered as a renewable energy source, because the methane-rich biogas produced is suitable for fuel gas. It can replace liquid petroleum gas (LPG) in household uses.[3] Rice straw and organic fraction of market solid wastes (mainly consists of residual fruit and vegetable wastes) are potential biomass to produced biogas. Chemical composition of rice straw is influenced by several factors, such as paddy variety, growing location, and type of fertilizer applied. In Indonesia rice straw usually contains 40-43% carbon, 0.4% nitrogen, 0.02 % phosphor, 1.4% potassium, and 5.6% silica.[4] This research work evaluates the potential of rice straw and organic fraction of fruit and vegetable wastes to generate biogas. In particular, the effect of varying the mode of feeding during semi-continuous fermentation process was investigated.

Materials and method

Materials

The material for the experiment was rice straw obtained from paddy field, and the organic fraction of market solid waste collected from traditional market in Bogor (Gunung Batu and Laladon). The materials were chopped to about 2 cm in size. Fresh cattle manure obtained from cattle farm was used as seeding of the anaerobic bacteria.

Equipment

Digesters with the capacity of 1.5 L and 10 L were used in the experiments. A set of 1.5 L Erlenmeyer flasks was used as the smaller digester. The gas production was measured by the water displacement method.

Results and Discussion

Biomass Characteristics

Table 1 presents the characteristics of several types of biomass in terms of its total and volatile solids. The rice straw used in this experiment was not fresh straw, but a few days old (after harvested) straw.

Table 1. Characteristics of various types of biomass

Types of Biomass	Moisture Content (%)	Total Solid (%)	Volatile Solids	
			(% wb)	(% db)
Rice Straw	18.70	81.30	53.24	65.47
Market waste of Gurung Batu	82.57	17.43	15.2	87.19
Market waste of Laladon	94.05	5.95	5.12	85.96
Cattle manure	84.23	15.77	12.5	79.27
Banana peel	87.61	12.39	10.50	84.70
Cabbage	93.00	7.00	6.52	93.08
Pineapple	86.61	13.39	12.73	95.07

source:[4]

Biogas Production Potential

Small digesters with working volume of 1.5L were used to determine the biogas production potential of several individual types of biomass. Experiments were run at room temperature for 45 days. At the initial state of fermentation the gas production rate was higher due to the content of relatively easily degradable organics. Rice straw generated the smallest amount of gas production, about 8 L/kg VS, which was reached after day 40 of fermentation.

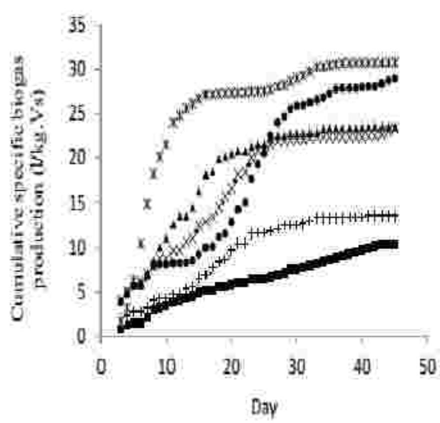

Figure 1. Profile of cumulative specific gas production of several types of biomass (¡ rice straw, p banana peel, x cabbage, Ý market waste of Gunung Batu, ˜ market waste of Laladon, É pineapple peel)
source:[4]

Organic solid waste collected from Gunung Batu market generated the highest production of biogas, about 32 L/kg VS, which was reached after 35 days of fermentation. The market wastes have shown to be more easily degradable than the rice straw. The individual type of biomass, such as banana and pineapple peel as well as cabbage generated gas at the amount between that of rice straw and the solid wastes mixture. The slower rate of gas generation of rice straw was due to the high content of lignocellulosic materials. Therefore, pre- treatment is required for rice straw to improve its rate of hydrolysis. The pre-treatment needed could be physical (such as size reduction), chemical (such as alkali addition), or biological treatment (such as bio oxidation and enzyme application).

Effect of Temperature

The similar experiment was also conducted using the same digesters at a controlled temperature of 32°C. As shown in Figure 2 the rates of gas production for both types of biomass were higher than those at ambient temperature. In the case of rice straw, a much shorter fermentation time of only 17 days was required to get the maximum specific gas production of 10 L/kg VS. For market waste, the higher cumulative gas production of 50 L/kg VS was obtained in less than 20 days of fermentation. As shown in Figure 2 specific gas production of market waste was higher than that of rice straw. The methane producing bacteria operate most efficiently at temperatures 30°C – 40°C or 50°C – 60°C [1]

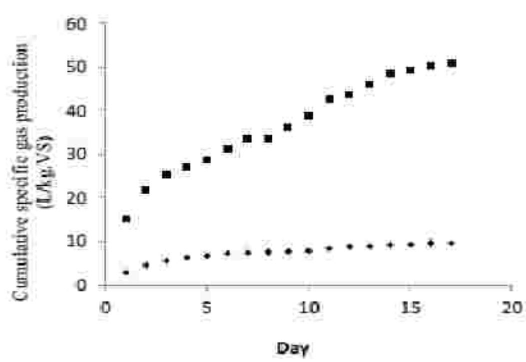

Figure2. Cumulative specific gas production of the digesters run at 32°C (¿ rice straw and ¾ market waste)
source:[4]

Mode of Feeding

Biogas Generation

This experiment was conducted to evaluate the best feeding mode when the digester was run in semi-continuous operation. Digesters were initially run until a maximum gas production was achieved. Three modes of feeding were done by replacing 50%, 75% and 100% of digester content with new fresh biomass. Figure 3a shows that 75% replacement of the old digester content with fresh rice straw resulted in biogas production of 42 L/kg VS, much higher than 50% replacement, which only generated 16 L/kg VS.

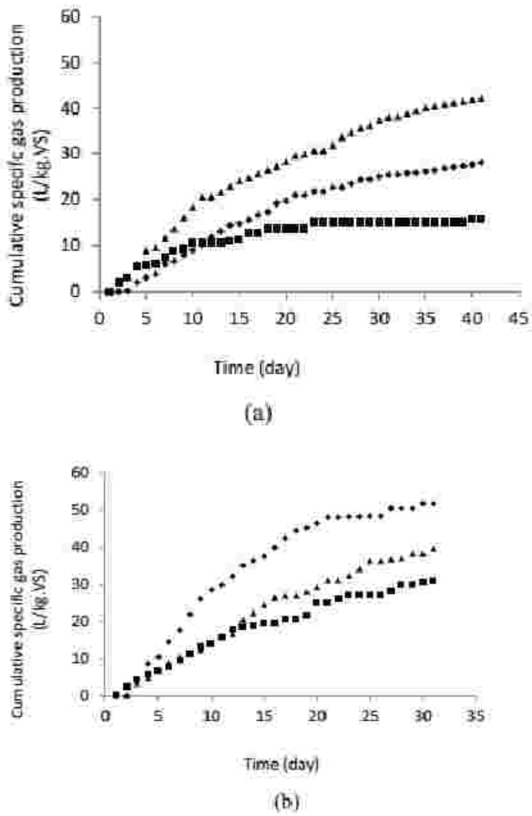

Figure 3. Effect of feeding mode on biogas production (a) rice straw and (b) market waste: control digester (¿), 50% fresh feed (¾) and 75% fresh feed (p)
source:[4]

Similarly, with market waste, 75% feed replacement also generated 40 L/kg VS specific gas production which is higher than 50% feed replacement, which is 31 L/kg VS (Figure 3b). It was noted also for rice straw biomass that both 50% and 75% feed replacement led to higher gas production rate at earlier stage of fermentation (see figure 3). But at a later stage of fermentation, the gas production rate of digester with 50% feed replacement decreased and ended up with the lowest total biogas production as compared to 75% feed replacement. This could be explained that digester run at 50% feed replacement contained the lowest organic load. The digester run at 75% feed replacement generated the highest gas production because of the higher organic fraction. Different response occurred in the digesters fed on market wastes. Values of biogas production rate in control digester, 75% feed replacement and 50% feed replacement were 560 mL/day, 410 mL/day and 360 mL/day. Figure 3b shows that the gas rate and the maximum gas production were a function of organics load. The higher the organic load the higher the gas rate and the cumulative gas production. It is suggested that digested slurry of previous batch of fermentation should not be emptied completely, but a certain quantity should be mixed with the new feedstock to improve biogas production.[5]

Conclusion and recommendation

Conclusions

The results of the experimental works showed that the anaerobic digester performance was strongly influenced by the type of biomass, process temperature and feeding mode. Faster biogas formation was observed in the digester fed on market waste biomass, which contained more proportion of easily biodegradable materials compared to that fed on rice straw.

The mode of feeding 75% of replacement by market wastes produce more began than 50% feed replacement as it contains more organic wastes. Similarly for rice straw, at the first stage maximum biogas was produced by 50% and 75% feed replacement. At later stage, production rate with 50% feed replacement decrease earlier than 75% feed replacement.

The anaerobic digestion of residual agriculture biomass enabled the recovery of organic carbon and nutrients of the biomass into biogas as source of energy and digestate and leachate as soil improver and fertilizer.

Recommendation

The biogas formation for both types of biomass was still lower. Biogas formation can be increased by improving the feed composition such as co-digestion of two or more types of biomass. Co-digestion of vegetable or food wastes with animal wastes has better efficiency of biogas production. Co-digestion enables the deficiency in one type of substrate to be compensated with the other co-substrate.

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Urban Social Sustainability: In the Livable Streets of Kathmandu Durbar Square

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Abstract: Sustainability and Sustainable Developments are the current issue in the developing and developed Nations. Among the three pillars of sustainable development, one of the aspects i.e. social sustainability has been taken into consideration as gap has been found while doing the literature review on the sustainability. The main aim of this research is to study the urban social sustainability and its various contributing factors in the context of the oldest heritage area of Kathmandu valley. i.e. Kathmandu Durbar Square. On the basis of the literature review and field observation, this article has been researched. This study can be used by the students, Urban designers, planners, those who are working in the field of Sustainable developments etc.

Key words: Urban, Social Sustainability, Streets and Kathmandu Durbar Square

1. INTRODUCTION

The word "Urban" is simply defined as the city or densely populated area where all the facilities are available. Such as Transportation, Communication, Shopping Complex, Schools, College, Hospitals etc. The Former Norwegian Prime Minister , Gro Harlem Brundtland defined sustainable Development as the development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Social Sustainability is the sustainability in a social manner. Therefore, Urban Social Sustainability is the sustainability in the Urban area in the case of Kathmandu Durbar Square which is one of the oldest Heritage Zone in Nepal.

Sustainability is the most renowned topic these days in every parts of the world. It consists of the three pillars. i.e. social, economic and environment which are interdependent with each other. Such as Society depends upon environment and economy for carrying out any kind of activity, Economy depends on the status of society as well as favourable and non- favourable environment.

Similarly, environment depends on the society as well as the economy. Among these three pillars of Sustainability, economy and environment pillars are considered most whereas the social pillar is the poorest one which have been neglected. (Ghahramanpouri A. et al., 2015)Various definitions of social sustainability has been proposed by the authors. "According to Laguna, Ahman and Colantonio, social sustainability is concept intangibility in compare to more tangible and measurable concept of environmental and economical sustainability. According to Littig and Griessler, use of other social concepts, theories, instead of defining the concept itself, the multifaceted nature of social sustainability that causes existence of several definitions depending on varying scale, scopes and perspectives, related to dynamic characteristics of the concept as it is associated with people and society and their changing needs and conditions." (Ghahramanpouri A. et al., 2015) Therefore, the social sustainability is one of the vague topic and very difficult to theorize. Among the studies conducted, the social sustainability in the context of Kathmandu has not been focused and taken into consideration. Similar the research on urban areas, its streets which include public spaces such as Kathmandu Durbar Square has not been conducted. Therefore, there seems to be gap on the Urban Social Sustainability issue in the context of Kathmandu Durbar Square.

2. OBJECTIVE

The General objectives are:

§ To study the Urban Social Sustainability in the context of Kathmandu Durbar Square.

The Specific objectives are:

§ To study the Social Sustainability in the live streets of Kathmandu Durbar Square.

§ To find out the components of Social Sustainability.

§ To find out the Urban Social Sustainability dimensions in public space.

3. RESEARCH QUESTION

To adequately achieve above objectives, the following research Questions are formulated. They are:

§ How the social aspects of Sustainability are Context dependent?

§ What are the social sustainability aspects in the case of Kathmandu Durbar Square?

§ How is social sustainability maintained in the streets of Durbar Square?

§ How can social sustainability be improved?

4. LITERATURE REVIEW

Social sustainability is about people's quality of life, now and in the future. It describes the extent to which a neighbourhood supports individual and collective well-being. Social sustainability combines design of the physical environment with a focus on how the people who live in and use a space relate to each other and function as a community. It is enhanced by development which provides the right infrastructure to support a strong social and cultural life, opportunities for people toget involved, and scope for the place and the community to evolve. (Group, 2008)

The framework consists of four dimesions: "infrastructure and social amenities", "voice and influence", "social and cultural life" and "change in the neighborhood" which are underpinned by 13 indicators. Data from 45 questions in total created the results for each indicator. Primary data was collected through a face-to-face residents' survey and a site survey. (Group, 2008)

Fig-1 Four Dimensions of Social Sustainability

Fig-2 Thirteen Indicators of three dimensions of Social Sustainability

There is increasing global interest in social sustainability, amongst policy makers, governments and the various agencies involved in the process of house building, planning and urban regeneration. The term originates from the ‘three pillars’ of sustainable development – environmental, economic, social – which date from the 1987 Brundtland Commission to the United Nations. The former Norwegian Prime Minister, Gro Harlem Brundtland, defined sustainable development as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”. Over the past decade a body of academic research has emerged that has attempted to define and conceptualize social sustainability and to map out its key characteristics and principles. (Group, 2008)

Fig - 3 Urban Social Sustainability: contributory factors as identified in the review of Literature

Another component of social sustainability is the inclusion and participation of multiple perspectives and individuals including the public. There is a large volume of literature on public and stakeholder participation in environmental decision making and this can be extended to sustainability. (Rogers S.H., 2013)

Following figure presents a diagram indicating influencing urban social sustainability dimensions in public spaces such as connectivity, Legibility, sense of place, preservation of local characteristics, safety, comfort, public services, social amenities, inclusiveness and diversity. (Ghahramanpouri A.,

Fig - 4 Significant factors affecting social sustainability of urban places

5. METHODOLOGY

In my research, the methodology I followed was the descriptive, explanatory and based on field observation. This research has described about what the third pillar of sustainability i.e. social sustainability is and why is it important in the developing and developed countries like Nepal.

The research is based on the Positivism/ Post positivism paradigm as well as Constructivism paradigm. The data’s are all taken from the literature and the perception of the people, their behavior was taken with the help of Constructivism paradigm as it is based on subjective reality.

The most important part that I did was the Literature Review which was the key foundation for conducting this research. The definitions and the case studies that were done in the literature review has helped me to write an article on “Urban Social Sustainability: In the context of Kathmandu Durbar Square” which has not been taken into consideration as the important aspect of social sustainability. During Literature review, the case studies that were studied were: the journal on U ban Social Sustainability Contributing Factors in Kuala Lumpur Streets, city of Vancouver, in Australia, the study performed by Porta and Renne (2005) about the social sustainability on small-scale built environment units i.e. street, utilizing formal indicator concept, the study on social sustainability of Urban Renewal projects in Hong kong. Also, the articles on social capital and walkability as social aspects of sustainability and social sustainability and new communities: moving from concept to practice in the UK.

The tools for data collection in this research are Literature reviews on the definitions, operational themes, succeeding factors, Reviews on the case studies as well as field observation. After the review, the field observation was done on the basis of the social themes and social characteristics which were mentioned in the first article. i.e. Urban social Sustainability Contributing factors in the street of Kuala Lumpur. The field observation on walkability and social capital were also done.

After taking the data's from the literature and field observation, the various components and the themes were analyzed on the basis of comparison and the findings have been drawn. Finally, the conclusion has been drawn based on the literature review, field observation and analysis.

6. STUDY AREA

The study area of my article is the Basantapur Durbar Square area which is one of the World's Heritage Sites and lies at the heart of the Kathmandu. It is the Durbar Square complex area with the Gaddi Baithak, Museum, Kumari home, dabali, shiva parvati temple, Nautale Durbar etc.

7. RATIONALE OF STUDY AREA

Basantapur area, being located at the heart of the Kathmandu i.e. near New Road, being one of the area for its cultural heritage, being the centre area for carrying out the festivals such as Indra Jatra, Fagu Purnima etc., lying in the traditional Newari settlement and the availability of vegetable markets during the morning and evening hours, it is very important to know how the social sustainability is going on in this multifunctional area and is it sustainable or not.

Also, the area is found to have carrying our certain social programs like musical programs, arts related, culture related programs, blood donation etc. and various group of people from the children to the adult and old age, couples, families etc, are found to be spending their time in this area. Therefore, it is very necessary to know about the issues related to the Social Sustainability in this area.

8. FINDINGS

Field Observation

Kathmandu Durbar Square area has the mixed land use such as Residences, traditional markets, cultural heritage etc. This area mostly comprises of the stones for the pavement and there is the continuous flow of people especially in the morning and evening. especially, this area in the morning is found to be crowded because of the cultural, religious belief of the people as well as due to the vegetable market and in the evening, gatherings of the couples, family members etc to get the fresh air as well as to spend their time with their family.

Due to the rules made by Municipality, the vehicles such as car, motorbike, vans etc are not allowed in this premises which is promoting the social sustainability as well as reducing the noise, pollution and the crowd in the complex area. Now-a–days due to the damage made by the earthquake, the huge vehicles are prohibited.

9. RESULT

Therefore, by comparing the Literature review and the field observation, it is clear that the Kathmandu Durbar Square has its social sustainability. And also after the earthquake, people do their gatherings there with their friends and family members. Especi the teen agers and the younger generations are found to be hanging around this area after 5 ‘o clock in the evening after they are off from their workplace, college etc. The dabali’s which are the hard open areas have been used by the people for various purposes like the gossiping, playing, displaying antique handicraft items for sale, tea shops and people around for the tea as well as their discussions.

Most of the people nearby are found to be Newars so they do not find difficulty for buying vegetables, fruits and any other thing as everything is found nearby. The visitors also park their motorbikes at the edge of the heritage area and they walk around. For the tourists, the gates are provided so for the entrance, they need to take the ticket from the booth and the area is pedestrainized. Hence this area is a walkability area and the entry of vehicles in the early morning and in the evening has created a problem regarding the social sustainability.

CONCLUSION

Therefore, social sustainability is one of the understudied topic which has been investigated through this research in the heritage area of Kathmandu, Nepal. There are various factors that guide the social sustainability and also it is one of the context dependent topic as it depends on the people of the society, their culture, behavior etc. the public spaces and the streets are one of the vital part of the social sustainability because of its livability of streets, the phenomena and the actions that take place in the streets, squares and public places during the festive time. The knowledge about the social sustainability contribute to the local authorities, Government, Urban planners and Designers to provide more socially successful, sustainable places and streets. When the importance of the social sustainability and its factors are realized and improved in the current and future public spaces, it could be expected that such spaces could serve the users for longer period of time in the future in terms of social and functio

RECOMMENDATION

This article is recommended for the urban planners, designers, local bodies, government etc. so that they could consider the social sustainability issue in their future designs.

ACKNOWLEDGEMENT

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Rural Energy Planning; Potential of renewable energy in Nepal

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Abstract: Nepal contains larger share of population living in rural areas. Increasing rate of urbanization possesses challenges in energy planning. Energy gap can be decreased by developing renewable energy units which is supplied through local distribution network. Various studies related to rural planning and integrated energy planning have been studied in order to comprehend contemporary scenario of subject matter. Biomass energy, solar energy, wind energy, mini-micro hydro projects have been considered to alleviate energy poverty in rural Nepal.

Keywords: Rural Planning, Energy planning, Renewable energy, Integrated energy planning

Nomenclature

IEP	Integrated Energy Planning
ICS	Improved Cooking Stove
AEPC	Alternative Energy Promotion Center
IAEA	International Atomic Energy Association

Background

Remoteness possesses challenges in everyday living. Mobility, housing conditions, livability, ecology, land quality, availability of natural resources and as a whole human activity tissue greatly differs with respect to remoteness ascribing topology. Around 50% of world population is rural population, which pertains half of world population living in rural environment, with exceptionally fast growing urbanization. Rural scenario in Nepal presents energy poverty, traditional energy sources (low grade fuel sources), economic disparity, degrading land productivity, lack of agro-marketing chain, lack of introduction of modern agricultural technologies. While focusing on energy situation of rural Nepal, 77 percent of the energy demand is met by fuel wood, 9 percent by agricultural residues and animal dung, 14 percent by imported petroleum products, coal and electricity in the energy consumption. (GoN, 2006) Improvements in scope of procurement of local renewable energy sources have been in form of biogas, improved water mills, hydropower electricity (micro and mini hydro), solar energy and improved forms of biomass. End use of energy in rural Nepal may be broadly held to account for cooking, lighting, motive power, agriculture and transportation. Contemporary introductions of urban transport characteristics has been use of private-motorized-vehicle i.e. motorbike; *bike culture*. Similarly, increasing use of petroleum based fuel consuming machines for agricultural activities, and accessibility to modern forms of electrical devices is resulting in feeling of urban inclusiveness.

Earthquake of year 2072 B.S. (2015) resulted in loss of built infrastructures in hilly regions located east wards of epicenters. This caused increasing demands and concerns for new housing demands and infrastructural development at earthquake affected regions. Along with the need to rebuild and develop the nation, it is a prerequisite for accessibility to energy demands.

Access to better living conditions, aspiration of economic development, social equity has been essential for larger population share, living in rural areas. The fact that, the rural population of Nepal decreased from 86 percent in 2001 to 83 percent in 2011 (NepalMonitor, 2011) demands concerns for planning. Policy making and development practices should outline sustainable measures to ensure rural development.

Introduction

Any planning activity that intrinsically or extrinsically influences socio-economic and environmental aspects of rural living can be practice of rural planning. Its broad concerns are related with people earning their living and also preserving environmental, natural and social resources of the place, i.e. planning of human capital and physical resources which differ to that of an urban environment in density, municipal governance, clustered services and infrastructures. Increasingly in rural planning, in addition to the concern about equity and opportunity in urban versus rural contexts, here is a concern about the increasing economic gap between the affluent and those in jobs that pay minimum wages. (Dandekar, 2015)

Planning and Energy

Planning is a process of making considerations for something. It is a strategic approach to a condition to reaching a goal by realizing its nature and needs. Planning process comprises of rigorous study on the phenomenon of what is being planned for. Its objective is to ensure essentials for future. Energy planning is an example of the need for the vital role of government institutions in ensuring that energy supply and demand decisions made by all stake holders – producers, consumers, investors, etc. – are compatible with overall goals for national sustainable development (IAEA, 2015). Planning encompasses activities in its entirety, hence role of energy plays crucial role in producing desired output. Meeting energy demands is a must for completion of any planned activity. Hence, allocation of energy, finding renewable sources, and its economic-social and environmental sustainability is sensitive issue when it comes to sustainable energy planning solutions. Supply and demand side management with energy efficiency solutions is how mostly planning practices have been done. Integrated energy development approach views energy not as a static good to be estimated and supplied, but as a dynamic input capable of catalyzing economic and social development. (OAS, 1988) Integrated energy planning strategies have evolved in recent years to provide apt means to optimize energy sources. Integrated energy planning is the systematic analysis of all the factors that influence the evolution of energy systems. It facilitates problem solving and makes it possible to explore linkages, evaluate trade-offs and compare consequences, thereby helping countries to develop an effective energy strategy that supports national sustainable development goals. (IAEA, 2015)

Objective:

The objective of this writing is to discuss on aspects of rural energy planning and its scope in provision of local renewable energy sources. Traditional energy is gradually getting replaced by high grade fuels, such as petroleum fuels, electricity, LPG etc. The introduction of new sources of energy means introduction of new measures to get an activity done. This results in differences in impact in social, economical and environment to that resulted by activities as done during traditional times. Hence, while it comes to matter of sustainability, energy; its source, efficiency and availability need to be carefully assessed.

Methodology:

This writing is based on literature review and doesn't contain findings from primary research. Various secondary sources related to subject matter have been studied to infer renewable energy potential. As the scope of writing is confined to preliminary case studies of journal from various fields, all pertaining to energy planning and rural planning, there are limitations of this paper regarding new findings and filling the research gap. Input are solely based on observation of contemporary scenario and secondary reading materials.

Potential of renewable energy:

Nepal, rich in water resources, has huge potential in harnessing electricity from running rivers. The theoretical potential of hydropower in Nepal is 83000 MW (GoN, 2006), of which about 50% is technically and economically feasible. Our total generation is around 800MW, which hasn't met current demands. Mini and micro hydro-power projects are one of the means to ensure rural electrification. It is source of renewable energy that can be harnessed to ascertain socio-economic benefits to the local and thus alleviating rural energy poverty. Along with this potential source, there ought to be alternative sources of energy which is renewable too. Solar energy, wind energy, biomass energy and geothermal energy are renewable energy sources that could be tapped in our context. However, scope of later occurs at more than 28 places in Nepal (AEPC, 2008).

In Nepal, only 160,000 biogas plants have been installed out of the installation potential of 1.9 million biogas plants. (GoN, 2006) Introduction of Improved Cooking Stove (ICS) has greatly reduced consumption of firewood. Along with its environmental benefits, it also has improved indoor air quality of house, which has positive relation to healthy living. There has been savings in the energy consumption by installing 250,000 improved cooking stoves. (GoN, 2006) Similarly, in spite of huge potential of solar energy, only 75,000 solar home systems have been installed. Use of solar energy for drying of crops and food items has been there since ages. Solar drier, although sparsely mentioned, has great potential in aiding farmers in improving their economic conditions. Uncertainties of produce reaching in the market before it spoils, has been one of the major concerns for farmers living in remote areas, where transportation is difficult. Use of solar drier, could preserve the food items by removing its water content. Preservation of food items would ensure no loss in economy as well. Marketing those dried food in required packaging would not only ensure proper marketing but also add value to the product.

Hence, scope of solar drier in remote areas could provide security against loss of agricultural produce and enable marketing.

With regard to the wind energy, it has not been possible to harness its potential. High mountainous altitudes have potential of wind energy. AEPC has been conducting researches and its development since 1996. A case in point is the Kagbeni wind power project which was one of the biggest projects to date. Installed in 1987 under Danish Government funding it was able to generate up to 20 kW before lack of maintenance shut it down. (AEPC, 2008).

Up to now about 2,000 traditional water mills have been improved. Only about 8 MW power is produced through micro hydro. These efforts have made it possible to provide electricity services to about 40 percent of the population in the country. In the rural areas, only 29 percent of the population has access to electricity. (GoN, 2006)

Conclusion:

Rural development strategies should incorporate exploitation of renewable energy, sustainable practices which enhance socio-economic benefits along with least impact in environment. Decentralized energy planning may be a solution to reduce energy poverty in rural areas. (Nikolas & DimitrisC., 2016) mentions, it is preferable to create decentralized energy units and local distribution networks rather than connecting to the interconnected electricity grid lines in remote settlements. In case of Nepal, there is potential of micro-hydro projects to fulfill the need of electricity in rural areas, where there is feasibility. Potential of solar energy is yet to be exploited in remote areas, where surplus agricultural produce can be preserved to market to urban centers. This has implications on improvement of socio-economical benefits, together with creation of new working stations and new employment opportunities.

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Energy Efficiency in Building Construction

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Abstract: Energy is essential to our daily lives. It heats our homes, fuels our transport and supplies our electricity. At the moment, most of the energy we use comes from fossil fuels such as oil, gas, coal and peat. Unfortunately there is a limited supply of fossil fuels in the world and we are using them up at a very fast rate. The other downside to fossil fuels is that burning them for energy also produces CO_2, a greenhouse gas, which causes climate change. That's where sustainable energy comes in. In every building construction the use of sustainable energy or energy efficiency technology should be applied to reduce resource consumption, save money in the long run, and instill the importance on environmental sustainability. So, Energy efficient is the purposeful construction of buildings that decreases resource usage in both the building process and also the future use of the building. The goal is to reduce CO_2 emissions, energy use, and water use, while creating an atmosphere where everyone can have better health and environment.

Key words: Energy efficiency, Eco efficiency, Sustainable energy, Passive solar, Environment sustainability

1. INTRODUCTION

Energy efficiency is "using less energy to provide the same service". There are other definitions, but this is a good operational one. The best way to understand this idea is through examples: When we replace a single pane window in our house with an energy-efficient one, the new window prevents heat from escaping in the winter, so we save energy by using our furnace or electric heater less while still staying comfortable. In the summer, efficient windows keep the heat out, so the air conditioner does not run as often and we save electricity. When we replace an appliance, such as a refrigerator or clothes washer, or office equipment, such as a computer or printer, with a more energy-efficient model, the new equipment provides the same service, but uses less energy. This saves money on our energy bill, and reduces the amount of greenhouse gases going into the atmosphere. Energy efficiency is not energy conservation. Energy conservation is reducing or going without a service to save energy. For example: Turning off a light is energy conservation. Replacing an incandescent lamp with a compact fluorescent lamp (which uses much less energy to produce the same amount of light) is energy efficiency. Both efficiency and conservation can reduce greenhouse gas emissions. (sipila, 2011)Energy efficiency can be defined as a part of eco-efficiency. Eco efficiency is ecological efficiency that measures use of natural resources and disadvantages (negative impacts) in relation with results obtained. It can be defined as a part of sustainability.

Sustainability covers ecological (or environmental), economic and social (including cultural and institutional) sustainability. Especially because of climate change the ecological sustainability is becoming more and more the hard core of the whole sustainability target. Eco-efficiency is a commonly used indicator measuring the ecological sustainability. Energy efficiency in turn represents the hard core of eco-efficiency, especially when non-renewable energy sources are considered. Together with energy efficiency, material efficiency may be measured (decreasing energy consumption may increase consumption of materials and vice versa). Together with energy efficiency (kWh/product or service unit) it is possible to measure amount of emissions of carbon foot print generated by production and operation (e.g. CO2-eq. kg/product or service unit). In addition to energy efficiency, other changes in the study complex generated by energy production and use should be evaluated, e.g. on the community level quality of environment, on the building level quality of indoor air, in transportation accidents and noise, in industrial production coziness of working environment, safety etc. Buildings and the resources that are utilized to maintain working and living conditions, significantly contribute to the use and waste of resources that have a negative effect on the environment.

Simple measures can be implemented to improve energy use to enable the City to contribute to creating a more sustainable environment. The intent of energy efficient building design is to improve energy use to enable the City to contribute to creating a more sustainable environment. Energy efficient buildings provide the benefit of:

- Reduced energy costs for dwellings and commercial
- Greater natural comfort and amenity level to building occupants, and
- By virtue of reduced energy; reduced emissions of carbon dioxide and other greenhouse gases, and thereby impact on the natural environment (this will also assist in achieving Fremantle's 20% greenhouse gas reduction goal).

Energy efficient design principles addressed in this policy include:

- building and room orientation,
- orientation, size and shading of windows,
- roof and wall insulation,
- use of thermal mass (heat absorbing) materials inside the house,
- cross ventilation and draft proofing and use of breezes,
- landscaping, and
- Energy-efficient appliances.

2. OBJECTIVES

The objectives of this study are:

- To provide advice on the principles of energy efficient building design, to improve comfort levels to occupants, and reduce energy consumption
- To ensure buildings are well designed to achieve the efficient use of energy for internal heating and cooling
- To ensure that design for good environmental performance and amenity is considered in conjunction with other design and amenity considerations in the Fremantle context

3. ENERGY EFFICIENT DESIGN PRINCIPLES AND GUIDELINES

3.1 Site selection

Energy used in driving from place to place can amount to a significant proportion of a household's total energy consumption. By locating new houses near to work- places, schools, public transport routes, etc., transport energy consumption can be reduced. Transmission of sunshine through windows (passive solar heating) can reduce heating costs. The selection of a site which is exposed to the low-altitude winter sun can allow for passive solar heating. By selecting a location sheltered from the wind, heat loss from the building can be reduced. Shelter can be provided by nearby trees, adjacent buildings or surrounding hills. If no such shelter exists, it can be provided in time through planting trees or shrubs. In some, mainly rural, locations there may be potential for renewable energy sources other than solar, for example hydropower, wind power, wood, biogas, or heat which can be extracted from the ground or sea. The possibility of obtaining heat from a combined heat and power plant or group heating scheme may also influence the selection of a site.

3.2 Building Orientation and Layout

Properly orientated buildings take advantage of the seasonal sun movement by allowing the winter sun into the building, but excluding summer sun. This has the effect of improving the amenity to habitable and working areas by accessing the natural heating, cooling and lighting elements. During winter, the north face of the building receives significantly more solar energy (3-4 times) than east west sides. The northern side of the building is therefore a good location for living and primary working spaces that are continually occupied during the day, and which usually have the largest heating and lighting requirements. The time delay in heat penetrating the building also allows the benefits of such orientation to last well into the night. The winter solstice (21 June) is a critical time to assess solar access, where at 12 noon the sun's altitude (32^0) casts shadow lengths 1.43 times the height of an object (by comparison, at the summer solstice - 22 December an object casts a shadow only 0.16 times its height). Conversely, the low angle of the sun in winter allows the greater penetration of direct sunlight into buildings orientated and designed to allow this, while the higher angle of the sun in summer allows it to be excluded.

3.3 Building Fabric and Structure

3.3.1 Insulation

Levels of insulation higher than those required in the Building Regulations are in many cases economically justified. Insulation should be well distributed around the building shell. It is better to have a good overall level of insulation than, for example, a highly insulated floor with no roof insulation. Attention should be given to the avoidance of thermal bridges. These are “short circuits” across insulation, which are commonly found at lintels, jambs and sills of doors and windows, and at junctions where floors and ceilings meet external walls. They give rise to increased heat loss and possible condensation problems.

3.3.2 Ventilation

Adequate ventilation is essential to provide fresh air and to remove moisture, odours and pollutants. However, excessive ventilation during the heating season results in energy wastage and can also cause discomfort due to draughts. Controlled vents should be installed in every room; trickle or slot vents incorporated in window frames can ensure a reasonable amount of continuous fresh air and can be opened up or closed down to a minimum as required. Cooker hoods and small fan exhausts allow for controlled removal of moist air from kitchens and bathrooms, and prevent this air being drawn into living or bedrooms. Attention should be given, during both design and construction, to ensuring that the building is well sealed. Services should be designed with minimum penetration of pipework and cabling through the building’s insulated shell. Doors and windows should come with factory-applied draught seals. Porches and draught lobbies can reduce draughts at external doors.

3.4 Passive solar features

If the house is exposed to the low-altitude winter sun, glazing should be concentrated on the south facade. Window area on the north facade should be minimized to limit heat loss. Thermal mass within south-facing rooms, e.g. masonry walls or concrete floors, can absorb and store solar energy during the day and release it gradually during the evening. The heating system should have a fast response time and good controls to maximize the usefulness of solar gains. Overheating protection in south-facing rooms in summer can be provided by overhanging eaves, blinds, natural ventilation, thermal mass or other means.

3.5 Building materials

The embodied energy of a product is the energy used to produce it, and includes energy used in extracting raw materials, processing and transport, e.g. Irish-grown timber will incur lower transport energy use than timber imported from overseas. The embodied energy of a house is typically over five times its annual energy consumption and therefore equates to approximately 5-10% of the total energy consumption during the life of the house. The building materials selected should have minimum environmental impact during their entire life cycle, including manufacture, use and disposal. Building components should be designed for long life and durability, and ideally should be recyclable at the end of their operating lives.

3.6 Heating systems

Energy efficient houses need smaller heating systems than conventional houses. The resulting savings will help to pay for the cost of additional insulation. Boilers the heating system should be efficient, not only at full load, but also at lower loads. If looking at oil or gas boilers, we should ensure that the boiler complies with the EU boiler efficiency directive. In the case of gas boilers, we should consider condensing boilers, which cost a bit more but are highly energy-efficient. If selecting individual room heaters, consider room sealed, balanced flue units. Room heaters should be correctly sized for the room they are to heat and should be thermostatically controlled.

4. CURRENT METHODS TO INCREASE ENERGY EFFICIENCY BUILDING DESIGN AND CONSTRUCTION

4.1 Passive Solar Design Techniques

In building planning and design, passive solar techniques are those that take advantage of solar heat and light to offset the need for gas or electric heating, air conditioning, and lighting. They are different from active solar systems, such as photovoltaic solar panels, which transform solar rays into electricity for home use. Common passive solar tactics include south-facing building orientations that absorb and store solar heat during the winter and deflect solar heat during the summer, and "daylighting," or maximizing the use of windows and full-glass exterior walls, often covered in a heat-deflecting glaze, to allow natural lighting into the building's interior work spaces, while minimizing the heat gain that might normally result.

4.2 Thermal Storage

Thermal storage may be implemented in individual building projects in numerous ways. Some of the most common strategies include strategic window placement and daylighting design, selection of appropriate glazing for windows and skylights, appropriate shading of glass to prevent undesirable heat gain, use of light-colored materials or paint for building envelopes and roofs, careful siting and orientation, and appropriate landscaping. Shading strategies may include overhangs and porches, trees and other vegetation, removable awnings, exterior roll-down shades, or shutters. Passive solar heating systems in a building with south-facing orientation can be combined with solar heat-storing trombe walls or floors made with concrete, tile, brick, stone, or masonry that absorb solar heat, store it, and then slowly release the heat into the building.

4.3 Cooling Strategies

During the summer months, air conditioning systems consume much electricity. Alternative passive cooling strategies, especially when used in conjunction with thermal storage techniques that prevent heat absorption, may reduce the need for heavy air conditioning. Such cooling techniques include the use of natural ventilation, ceiling fans, atria and stairwell towers, evaporative cooling systems for dry climates, dehumidification systems, and geothermal cooling and heat pump systems. These methods can effectively remove heat from the interior of a building without the use of energy-intensive conventional air conditioning systems.

4.4 Daylighting

Daylighting techniques involve the incorporation of natural daylight into the mix of a building's interior illumination. When properly designed and integrated with electric lighting, daylighting can offer significant energy savings by offsetting a portion of the electric lighting needed. A side benefit of daylighting is that it also reduces the internal heat gain from electric lighting, thereby reducing required cooling capacity. Results of recent studies imply improved productivity and health in daylighted schools and offices. Windows—the principal source of daylight—also provide visual relief, a visual portal on the world outside the building, time orientation, and a possible source of ventilation and emergency egress (U.S. Dept. of Energy. Building. "Daylighting"). Other sources of daylight include light pipes with mirrored inner surfaces that bring natural light deep into a building interior, skylights, skydomes, and reflective devices and surfaces that spread daylight more evenly in occupied interior spaces.

4.5 High-performance Insulation

A type of super-insulating material increasingly used for residential and light commercial buildings is structural insulated panels used in floors, walls, and roofs. The panels are manufactured by forming a sandwich of rigid foam plastic insulation between two panels of plywood. The panels generally cost about the same as building with wood-frame construction, but labor costs and job-site waste are reduced (Structural).

5. METHODS TO DECREASE ENERGY USE BY BUILDING OPERATING SYSTEMS

Most large, multistory buildings employ sophisticated, computer-based building control systems that integrate key subsystems such as lighting, security, fire protection, heating and air conditioning, occupancy sensors, and large networks of programmable thermostats. Such operating and control systems afford a high degree of fine-tuning capability and operating flexibility for differential environmental control in various locations of a building, depending on their exposure to daylight and weather conditions. Other methods include rooftop wind turbines and geothermal heat pumps.

6. COMMERCIALLY VIABLE OPTIONS

There are emerging technologies being developed to increase energy efficiency. One such technology is electrochromic windows that can instantly switch from transparent to varying shades of grey in response to a small, applied current. A large view window made with electrochromic materials could be programmed to respond to incoming natural light by stepping down its setting to minimize light transmittance. When integrated with daylight and occupancy sensors and programmable controls, electrochromic windows could be set to automatically and incrementally shade indoor environments in synch with the sun's arc across the sky.

7. ENERGY EFFICIENT DESIGN AND CONSTRUCTION RECOMMENDATIONS

(Energy and Environmental Building Association, 2006) (Building An Energy Efficient Home) Building design and construction should address the following objectives for design, construction, commissioning, operation and maintenance for better energy efficiency:

i. Building Structure

- Thermal transmission through heat loss and heat gains should be reduced by the specification and installation, with proper attention to detail and quality assurance, of increased levels of thermal insulation.
- Insulation systems should be installed such that they reduce convective, conductive and radiative heat losses and gains.
- Moisture gain resulting in decreased thermal and structural performance should be controlled.
- Fenestration systems should be selected according to climate, building orientation, interior comfort, day lighting, ventilation, furnishing durability and egress requirements.

ii. Mechanical Systems

- Indoor air quality should be facilitated by the installation of a controlled mechanical ventilation system. Heat recovery is recommended in severe heating climate zones.
- Only sealed combustion or power vented direct combustion appliances should be installed in occupied spaces.
- Thermal and peak load reductions derived from improving levels of insulation, air tightness and fenestration performance of the building envelope should be evaluated in the sizing of equipment.
- The domestic hot water system should meet high efficiency standards. Options for reducing water consumption are recommended.
- Solar energy for hot water heating should be considered.
- Efficient illumination design and lighting systems should be used. Natural lighting of spaces should be considered prior to specifying electric illumination systems.
- Other lighting fixtures should use compact fluorescent lamps.
- Major appliances should meet high-energy efficiency standards using current appliance ratings

iii. Occupant Considerations

- A comprehensive operations manual should be provided to occupants, which includes necessary operating, maintenance and repair information so that the performance of the building can be maximized.
- Systems that provide control over space conditioning, hot water or lighting energy use should be clearly marked. Information relating to the operation and maintenance of such systems should be provided to occupants.

8. CONCLUSION

Energy efficient design always plays a significant role in our work. While the aesthetics of a building are important, it is essential to have a building that performs too. Energy efficient systems that use less water and provide clean air and natural light are staples in the buildings we design. Sustainable design is also financially responsible and results in major savings in operational costs in the long run. And for scholastic institutions, a sustainable building is often the best teaching tool. In every building construction the use of sustainable energy or energy efficiency technology should be applied to reduce resource consumption, save money in the long run, and instill the importance on environmental sustainability.

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Employment effects of renewable energy technologies

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Abstract: Need of deployment of renewable energy technologies in different countries form a crucial part of governments' strategies to prevent climate change and to practice sustainable development for economic growth and development. For this many researchers have tried to find the different advantages of Renewable Energy Technologies (RETs) which can ease in the formulation of policy. And for that, governments, many times, try to relate the advantage in the term of employment that can be generated due to renewable energy deployment. This articles first highlights the drawbacks of policy makers, that they over optimistically calculate the employment generation of RETs and also the failure in considering all four employment outcomes that are anticipated as a consequence of switching to a low carbon economy. This article gives a very clear guideline for the assessment impact of RETs and helps the policy makers to find the jobs; specific skills required for different stages of RET deployment and make policies for sustainable development planning.

Key words: RET, Employment effect, PANTA RHEI, Government, direct and indirect employment effect

INTRODUCTION

Increasing the share of Renewable Energy system – Employment (RES-E) is expected to play a fundamental role in the fight against climate change by shifting Europe's energy dependence away from high carbon emitting energy sources. Consequently, it is important that the implications of this change on the labor market are assessed, especially in light of the economic crisis, whereby unemployment in Europe has been left at an all-time high. Additional investment in RES will obviously induce economic activity and employment. A distinction is typically made between four employment outcomes that are anticipated as a consequence of switching to a low carbon economy. It is expected that: additional jobs will be created; jobs will be substituted; jobs will be eliminated; and existing jobs will be transformed (UNEP, 2008). With varying definitions of what a 'green job' is, present figures estimating the potential employment impact of a transition to a low carbon economy vary considerably. According to ECORYS (2008), gross employment forecasts for Europe in the year 2020 range between 2.3 million to 21 million. Recent studies often focus on these gross employment impacts.

Situational analyses, such as Delphi (2007), account for the past development of employment in the renewable energy sector. Another type of papers applies econometric methods to analyze the past relation between the RE industry or the use of RES and economic development. A cross-country econometric study by Apergis and Payne (2010) reveals a possible correlation between RES investment and economic growth for a panel of OECD countries for the years 1985 to 2005. But higher cost for RES will be ''counterproductive to net job creation''. Especially for photovoltaic (PV), they conclude that due to high import shares the net employment impact of German PV promotion will be negative. The comprehensive EMLPOY-RES study (ISI, 2009) for the EU Commission applies two complex models, ASTRA and NEMESIS, for calculating the net impacts. Though showing some differences in detail, both models report positive GDP and employment net effects of advanced RES deployment of the EU in comparison to a no policy reference scenario. Economic impact of RES expansion is measured via the comparison of economic indicators such as GDP and employment from different simulation runs. The rising installation of renewable energy systems in some European countries such as Germany, Denmark and Spain, more recently also in other parts of the world such as China, has intensified the discussion of costs and benefits of renewable energy systems. Lower costs would make RE expansion more feasible, higher costs less feasible. This so-called budget effect reduces the available budget for other expenditures resulting in job losses in the respective sectors. The effects on employment of different scenarios for RE expansion have been analyzed in Lehr et al. (2008). The budget effect can work in either direction, as high PV electricity production during midday already avoids price peaks. With the further reduction of production costs and the better integration of RES into the electricity system, the average of future budget effects will tend to become less negative or even getting positive in the long run. Higher electricity prices may endanger international competitiveness of electricity intensive companies.

The differentiation between primary and secondary effects is crucial, since they show the impacts at different economic levels: at the RE industry level or the at the level of the whole economy – economy wide. For example, higher prices for electricity reduce the available relative income of private households. Under the assumption that demand for energy is relatively inelastic, the households' demand for other consumption goods shrinks. A shrinking demand for consumption goods leads to lower production and, hence, to lower input and, subsequently, to lower employment in the consumption goods industry. Taking into account the multiplier effect, namely that lower employment results in lower income of households and, hence, again in lower consumption, we have an enforcing negative effect in the whole economy.

METHOD

There are a number of identifiable methods that have been used to quantify the employment impacts of RES. However, in general, it is possible to categorize them into bottom-up and top-down approaches, or more specifically as using the analytical or IO method (World Bank, 2011; Silva et al., 2012). The first method uses survey or model plant data to establish the employment required to manufacture and operate a plant or certain piece of equipment and, therefore, it is a method that is most suitable to studies aimed at quantifying job effects of a precise energy project or industry (World Bank, 2011). Sterginzer (2006), for example, created a 'job calculator' which is based on a survey of current industry practices to measure the number and types of jobs resulting from the acceleration of renewable energy deployment. One of the main advantages of the analytical approach is that it can be made context specific and it is said to be more transparent than the IO framework (World Bank, 2011). However, the disadvantage is that it is less suited for forecasting economy-wide impacts as it cannot take into account the indirect employment effects, i.e. the effect on other sectors due to an increase in final demand for RES (Wei, 2010).

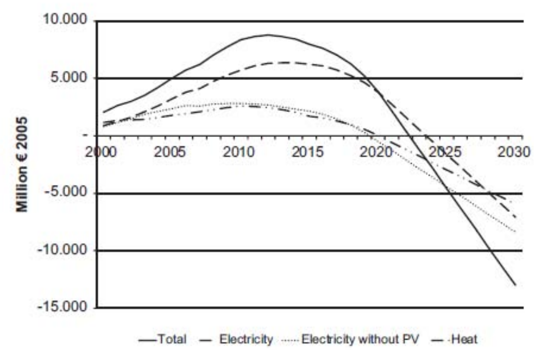

Fig. 3. Additional costs of renewable energy systems compared to the respective fossil fuel based generation in million € 2005 (Nitsch and Wenzel, 2009).

An IO table gives an overview of the flows of goods and interdependencies of industries. Based on the target output or investment intended in renewables, the level of associated employment can be calculated from this link (World Bank, 2011). The major drawback, however, is that because the RES sector brings relatively new concerns, current IO tables are not sufficiently disaggregated to straightforwardly arrive at employment estimates (World Bank, 2011).

PANTA RHEI (Lutz et al., 2005; Lehr et al., 2008; Meyer et al., 2012) is an environmentally extended version of the econometric simulation and forecasting model INFORGE (Ahlert et al., 2009; Meyer et al., 2007). Among others it has been used for economic evaluation of different energy scenarios that have been the basis for the German energy concept in 2010 (Lindenberger et al., 2010; Nagl et al., 2011). The behavioral equations reflect bounded rationality rather than optimizing behavior of agents. All parameters are estimated econometrically from time series data (1991–2008). Producer prices are the result of mark-up calculations of firms. Output decisions follow observable historic developments, including observed inefficiencies rather than optimal choices. The use of econometrically estimated equations means that agents have only myopic expectations. They follow routines developed in the past. This implies in contrast to optimization models that markets will not necessarily be in an optimum and non-market (energy) policy interventions can have positive economic impacts. The core of PANTA RHEI is the economic module, which calculates final demand (consumption, investment, exports) and intermediate demand (domestic and imported) for goods, capital stocks, and employment, wages, unit costs and producer as well as consumer prices in deep disaggregation of 59 industries. The disaggregated system also calculates taxes on goods and taxes on production.

Functional chains are also sometimes used for easy description of direct and indirect employment effects. The following figure illustrates the concept of functional chain.

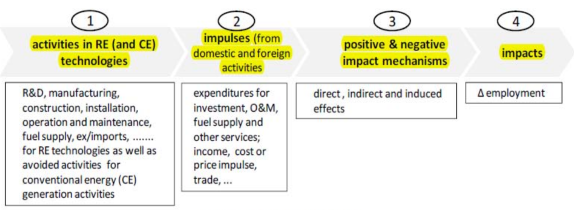

Figure 1: functional chain

RESULT

When comparing the number of direct jobs created due to installation of new facilities compared to those in operation and maintenance, the results confirm that the installation and construction of new facilities is generally more labor intensive as already discussed. The indirect employment effect is understandably larger for the installation compared to operation as the demands on the supply chain are likely to be much greater due to the need for different materials and services to construct the new facilities. The PANTA RHEI model calculates endogenously economic development and labor market effects in the different scenarios. The zero scenarios based on the low price path is now compared to a development with differing degrees of domestic investment in RE and differing export trends based on the same price path. The comparison of simulation results shows macroeconomic effects such as net employment effects which can be traced back to the different scenario assumptions.

CONCLUSION

Analysis shows possible positive impacts of the expansion of RE in Germany—and the conditions and policy implication for a positive development. Positive net employment effects strongly depend on further growth of global markets and German RE exports. When relating the results to studies which report negative impacts of RES promotion, the treatment of international market developments in the studies can explain at least part of the differences. Another important factor for employment impacts are expectations of future cost reductions of different RES technologies. The issue of economic impacts of the expansion of RE will be part of the sustainability discussion for the time to come. a quantitative analysis, as presented in this paper, provides a significant and vital step towards understanding the employment effects of switching to a low carbon economy, it is important to go beyond the numbers to truly understand how the transition will impact the workers.

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ENERGY GOAL ANALYZATION IN ECOCITIES

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Abstract: Due to the process of urbanization cities have gone through several structural changes. Cities are doubtlessly human's largest creation however along the history, mankind has put the city against the nature and the nature against the city due to the common sense that the first was disaggregated from the second or even opposite to it. Cities are far more than just buildings offering shelter to its inhabitants, cities are playing a major role in today's global energy system and will play an increasingly important role in the future global energy system. As the reaction to this, the concept of Eco Cities, has gained a foothold in the world and there are numerous commenced Eco City projects worldwide. However there are many aspects that needs to be taken in consideration when planning cities, and especially when planning cities with ambitious goal. One is normally and popularly referring to a holistic planning approach in Eco City developments and holistic thinking is often suggested as a key to success in Eco City projects. This paper discusses a model that was developed to assist the target setting in the planning process of Wuxi region in China. The model has been developed with a systems thinking approach, using STELLA. Different sectors comprising the Eco city i.e. built environment, transport, water and waste management and energy generation have been considered. In order to develop future scenarios for the Eco city the participation of various stakeholders is involved in the various stages of the project which is one of the key features of the tools. The stakeholders are involved in the problem formulation phase identify the main sub-systems and establishing initial system boundaries. This culminates in the form of a conceptual model which is further formulated to qualitative model which is calibrated, negotiated simulations are carried out for the generation of scenarios.

Keywords: Eco city, Energy System Modelling, Participatory Approach, Holistic Planning

Introduction

With the continuous increase of population, the dominant economic oriented societies and the current stage of technological advances in the application the process of Urbanization and the cities have undergone structural changes very often. In fact according to the UN projections, the global urban population is expected to increase to 72% by 2050. Despite covering only 2% of the worlds land surface, urban areas are responsible for about 67% of the world's energy use and over 70% of the greenhouse gases emissions. From this we can see that construction and operation of the cities led to the great destruction of the nature. Unfortunately, along the history, mankind put the city against the nature and the nature against the city due to the common sense that the first was disaggregated from the second or even opposite to it. This sense interferes on the way the city is perceived and affects the way it is built, bringing uncountable urban problems: polluted water, polluted air, resources shortage, frequent floods, and energy demand boost, among many other issues. Those problems use to be seen as if they were isolated incidents and not as interconnected and resulted from human's intervention without caring about nature's processes.

Thus, nature has been seen as a superficial beautifier, not as environment's essential part. On the other hand, the city was not considered nature's part as well and was not conceived, planed, designed, and managed under that condition. (Alina Goncalves Santiago, 2006). . Growing concerns regarding the 'peak oil', natural and manmade disasters on a global scale have led the city managers to rethink the planning approaches that have gone far beyond the human scale and have neglected nature as an integral part of the human systems. (Singh, 2015)

As the reaction to this, the concept of Eco Cities, has gained a foothold in the world and there are numerous commenced Eco City projects worldwide. Eco-City Builders Group that formed by Register in 1987, compiled eco-city planning principles in the international eco-city standards document.

These principles are as follows:

• Supporting clean air, safe food and water, healthy housing and businesses;

• Cost-effective eco-engineering solutions for the recycling of all waste;

• Production and usage of renewable energy;

• Development of efficient public transport system;

• Infrastructure integration that compatible with the natural qualities of settlements;

• Improving ecological (environmental and cultural) awareness.

Thus it is clear that there are many aspects that need to be taken in consideration when planning cities, and especially when planning cities with ambitious goal. One is normally and popularly referring to a holistic planning approach in Eco City developments and holistic thinking is often suggested as a key to success in Eco City projects. (David Stoltz, 2014). Through Systems Thinking the city is considered and seen as a system consisting of a number of interconnected subsystems that are coherently organized in a way that it reaches a set of goals. Thus, the subsystems are interconnected but have individual work tasks and carry out specific actions. With the set goals in consideration, the subsystems can be identified and analysed in order to understand how they interact so as to reach the set goals for the Eco City. Today, various examples of such Eco cities exist worldwide. While, varying in their particular focus areas, all these project have energy efficiency and lowering of GHG emissions as a common denominator. Where, all the concepts and underlying paradigm has changed from the 'conventional' to a new: ecological, the process has to be led by an inherently developed procedural process and actively participating local community, hence influential local politicians. There should be an R&D procedure, built in the process, with survey-data compilation- modelling- planning-design implementation. In the particular case of Wuxi Sino Swedish Eco City, a twelve criteria Eco City Innovation Idea to Deployment was also developed to serve as a qualitative guideline covering various stages of the Eco city development. This model covers various aspects including goal setting, holistic planning, balanced urban planning, Eco city management, dynamic energy systems, and energy efficiency and enabling innovative technologies. The main purpose for the model development was to assist with the target setting process of the Eco city and to compliment the model discussed in based on the various energy efficiency measures introduced in the project. Some of the other intended uses of the model include: Decision making tool for various technological solutions to be deployed.

Assistance in evaluation of the project.

Future energy and emission scenarios based on different trajectories.

Environmental	Social	Economic	Spatial
• Restoration of natural systems, • Usage of efficient and renewable resources • Development of local agriculture and urban gardening • Waste management and recycling	• Social Justice • Ecological awareness • Public consciousness • Participation • Protecting and supporting local culture	• Sustainable and non-polluting economic activities	• Compact land use • Mixed use • Reducing car use • Promoting short-distance public transport, pedestrian and bicycle transportation

Figure 1: Features of eco-city (prof Dr. Halagu Kalpan, 2015)

Tool for discussion and communication between various stakeholders. (Omar Shafqata, 2014)

Methodology

Eco city planning frameworks includes different models that are currently being used globally. Most of these frameworks with systems thinking as the focus, encourage a holistic planning processes, an integrated approach and effective use of resources. One of the key focuses of this model along with the various other planning frameworks discussed above has been target setting process in terms of energy use and emission targets. In order to accomplish this, Energy Target Identification and Deployment (ETID) Model was developed. The model builds on a systems thinking approach using STELLA modelling software. Different subsystems have been identified including built environment, transport, water and waste management and energy generation have been identified and possible synergy effects between them are taken into account which is the first process of the modelling. In the next step, models for each sub system were developed.

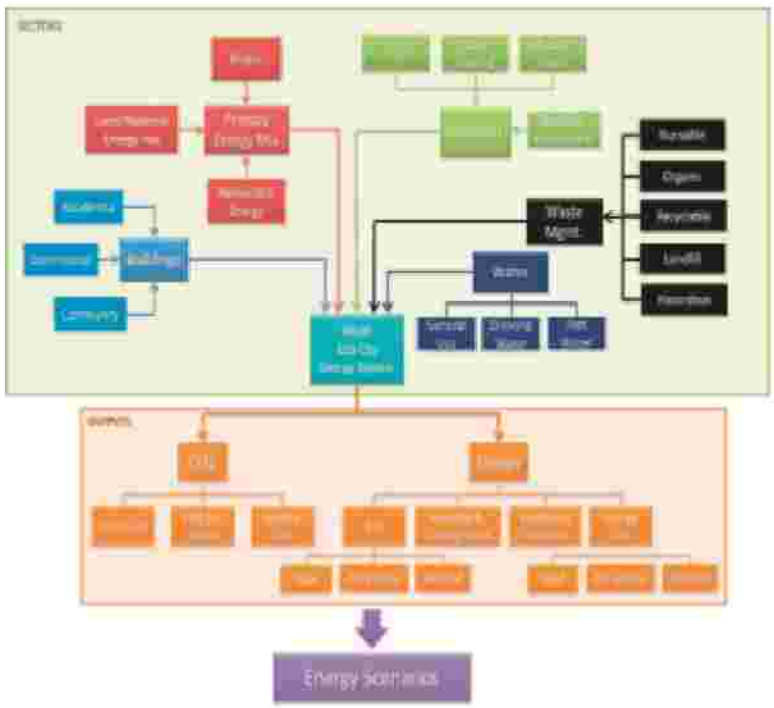

Fig 1: Conceptual model for Energy Target Identificaiton Model.

The model was developed with an interactive interface, which gives the user a possibility to change different assumption sets and therefore simulate different combination of the system.

The final stage of modelling involves generation of scenarios for the Eco City based on various combinations of key parameters. The model has its system boundaries at the Eco city level but various inputs from higher levels such as regional and national level are taken into account. The outputs of the model are energy use and CO_2 emissions in total and in per capita. (Omar Shafqata, 2014).

In order to develop future scenarios for the Eco city the participation of various stakeholders is involved in the various stages of the project which is one of the key features of the tools. These can serve as effective guidelines for assessing the process. The methodology provides an effective platform that is very inclusive about the stakeholder's points of view, both in the model development process as well as quantitative input parameters and this in turn serves as a validation for the results produced. Starting from the clarity less and very complicated ontology, the stakeholders are involved in the problem formulation phase identify the main sub-systems and establishing initial system boundaries. This culminates in the form of a conceptual model. Once it is completed the qualitative model is developed and with the stakeholders participation, important feedback and relationships are identified along with negotiating the assumptions, limitations data sources, model structure and system boundaries. The actual modelling process following this is typically "grey boxed" to the stakeholders. Once the model has been created and calibrated, negotiated simulations are carried out for the generation of scenarios. The exercise is generally carried out in the form of a workshop with the stakeholders and each parameter is discussed and negotiated. The quantified input parameters reflect the joint negotiated vision of future of the stakeholders. (Omar Shafqata, 2014).

Conclusion and Recommendation:

When studying cities there are many aspects to take in consideration, i.e. what kind of transportation system that is used and how it is operated, how the waste collection is managed and how the purification of water is carried out, as well as how the supply of energy is performed and which energy sources that are used etc. It is clear that there are many aspects that need to be taken in consideration when planning cities, and especially when planning cities with ambitious goals concerning energy use and greenhouse gas emissions reductions. However these aspects have their own complex relations. Thus this paper talks about the model that works with system thinking approach. . A participatory approach was adopted in the development of the model where different key parameters were identified as a result of a collaborative exercise with the various stakeholders. A framework for Participatory Modelling and Simulation has been developed. The model gives a possibility to visualize the energy saving potential for different technologies being proposed for implementation in the eco-city with which the possible disturbance that can occur at the any phase of the project may that be research, planning, implementation or operation can be pre addressed and made much more effective. Beforehand programming of funding social and physical infrastructure in advance of eco-development must be found. A properly funded and eco-comprehensive masterplan and following design procedure in spatial, social and economic terms must provide the long-term direction needed to give governmental agencies, public and private investors' confidence, along with enough flexibility-feedback and monitoring- to allow for changing circumstances.

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Biogas Production from Fruits and Vegetable Waste and their Effect on Plants When Used as Fertilizer (Using digested and undigested sludge)

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Abstract: Organic compounds decompose under anaerobic condition to yield biogas. This work presents results of the study on biogas production from fruits and vegetables waste materials and their effect on plants when used as fertilizer (Using digested and undigested sludge). It has been observed that the highest weekly individual production rate is recorded for the cow dung (control)slurry with average production of 1554 cm3, followed by pineapple waste which had 965 cm3 of biogas, then by orange waste which had 612cm3 of biogas, lastly, pumpkin and spinach wastes had373 cm3 and 269 cm3 respectively. The results obtained shows that difference in the production of biogas to a large extent depends on the nature of the substrate. All the substrates used appeared to be good materials for biogas production and their spent slurries can be used as a source of plant nutrients.

Key words: Biogas, Anaerobic digestion, Substrate, Vegetable waste, Cow dung

Introduction

The techniques used for the conversion of organic materials to biogas have been in existence for many years. Methane generation has been applied to meeting the energy needs in rural areas. In the England, India, Taiwan, for example, methane Generating units as well as plants using cow manure and municipal waste have been in operation for years. In United States there has been considerable interest in the process of anaerobic digestion as an approach to generating a safe clear fuel as well as source of fertilizer (Garba and Sambo, 1995). The use of rural wastes for biogas generation, rather than directly used as fuel or fertilizer, offers several benefits such as, the production of energy resource that can be stored and used more efficiently, the production of stabilized residue (sludge) that retains the fertilizer value of original material and the saving of energy required to produce equivalent amount of nitrogen-containing fertilizer by synthetic process. Indirect benefits of biogas generation include the potential for partial sterilization of waste during formation with consequent reduction of the public health hazard official

pathogens and reduction of fungal and other plant pathogens from one year's crop residue to the next. Biogas is a flammable gas produced when organic materials are fermented under anaerobic condition. It contains methane and carbon oxide with traces of hydrogen sulphide and water vapor. It burns with pale blue flame and has a calorific value of between25.9-30J/m3 depending on the percentage of methane in the gas. The gas is called by several other names, such as: dung gas, marsh gas, gobar gas, sewage gas and swamp gas (Dangoggo and Fernando, 1986).Biogas production involves the fermentation of organic materials such as agricultural waste, manure and industrial effluents in an anaerobic environment to produce methane (CH_4), carbon oxide (CO_2), and hydrogen sulphide (H_2S).The first stage consists of micro organisms attacking the organic matter where complex organic compounds such as cellulose and starch are converted to less complex soluble organic compounds. Polymers are transformed into soluble monomers through enzymatic hydrolysis

Data Collection and Analysis
All wastes ratio were analyzed for the following Parameters:
1) PH measurement: pH measurement was monitor reducing pH meter HM-25R (TOADKK). The mean PH was calculated from the collected PH results every day.
2) Total solids (TS) and total volatile solids (VS) standard methods: TS were determined at 1040C to constant weight and VS were measured by the loss on ignition of the dried sample at 5500C
3) Biogas collection: Biogas produced by anaerobic digestion was measured by water displacement method as shown in Fig.-2
4) Biogas composition: The Gas composition was

Analyzed by using a gas chromatography (GC-8AIT / CR8ASHIMADZU Corporation, JAPAN). Pressure: The pressure was higher than atmospheric level measured by gas pressure gauge

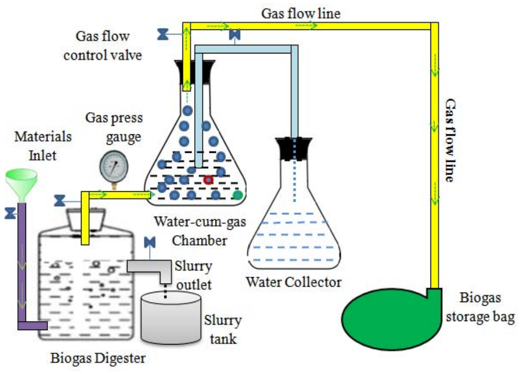

Fig:-1

Schematic for generation of biogas from solid biomass.

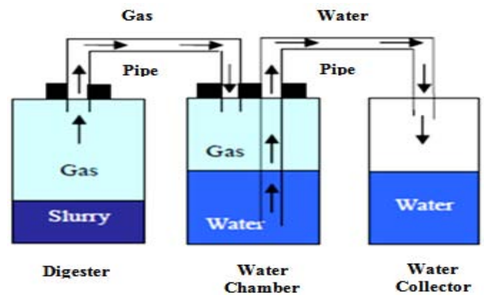

Fig:-2

Schematic of water displacement method.

The daily biogas yield reached the highest peak value for CW:VW:FW (0.5:1.0:1.5) mixture on 25th day, while the daily biogas yield for CW:VW:FW (1.5:0.5:1.0 and1.0:1.0:1.0) reached their peak value on 21th day. On the day24th, the CW:VW:FW (1.0:1.5:0.5) mixture reached its peak. Then biogas production declined as compared with the digestion time. The observed least gas yield from these digesters might be due to the production of volatile fatty acids by the microorganism which hinders the releasing of the biogas. This is in agreement with the report of who also observed low level of biogas production due to the lag phase of microbial growth during these periods of the run. (Torii, 2015)

Material and Methods

The materials used in this investigation as substrates were cow dung (control) and waste residue from fruits such as: orange, pineapple and vegetables such: spinach, pumpkin, all of which were agricultural waste materials.

Sampling and Sample Treatment

The waste materials were collected fresh from various locations around Kano and Kano metropolis, were sundried for twenty days then oven dried at 110oC for10hrs before use. The fruits waste were collected from Naibawa market along Kaduna-Zaria Express way, while the vegetables waste were collected from Yankaba market along Hadejia road and the cow dung was collected from Wu
dil cattle market. The dried samples were grounded using wooden pestle and mortar. By using sieving machine in order to obtain powdered samples which were then stored in a separate black polyethylene bags.

Fabrication of Digesters: -

Five portable digesters were fabricated using three-liter empty plastic gallons, bicycle valves, strip of rubber and polyvinylchloride(PVC) tube of 0.8 cm diameter. A hole was bored on the cover and the valves were inserted into the hole. Then, the (PVC) tube also inserted to cover the outlet of the valves. The tube was tightened using a strip of rubber. This was used as digester

Preparation of Slurry:-

From the dried samples, different slurries were prepared and used for theinvestigations.200g of each substrate was taken and mixed with 1.5litre of water and each transferred into a separate digester. The biogas produced, from the digester was connected to a separate inverted 1000cm3 measuring cylinder. The volume of biogas produced from each digester was recorded separately. The biogas production process was investigated for each of the substrate under investigation and was observed that the highest individual production rate is recorded for the cow dung slurry (control) with have range production of 1554 cm3, followed by pineapple waste which had 965 cm3 of biogas, then by orange waste which had 612cm3, pumpkin and spinach wastes had 373 cm3 and 269 cm3 respectively. Therefore, the difference in the production of biogas to a large extent depends on the nature of the substrate (Sagagi, 2009). The biogas production process was investigated for each of the substrate under investigation and was observed that the highest individual production rate is recorded for the cow dung slurry (control) with average production of 1554 cm3, followed by pineapple waste which had 965 cm3 of biogas, then orange waste which had 612cm3, pumpkin and spinach wastes had 373 cm3 and 269 cm3 respectively. Therefore, the difference in the production of bio gas to a large extent depends on the nature of the substrate (Sagagi, 2009)

Conclusion

Comparative studies on biogas production from different waste of fruits and vegetables using cow dung as control was carried out. From the results obtained, it can be concluded that, the vegetable wastes containing high carbohydrates are amenable to anaerobic digestion process and the maximum gas production was observed during 5-10 days of digestion. This shows that carbohydrates have been broken down much faster than the proteins and fats present in the waste and produced the gas. The mean methane production rate calculated on the basis of substrate concentration and the corresponding mean gas production show that the reactors can be operated safely till0.26gm VS loading beyond which inhibition of the process started. Similar trend was observed, in the specific rate constant value, k, calculated for the first order kinetics. The application of factorial (empirical) analysis using predictive models shows polynomial function seemed to be more reliable in predicting gas production in anaerobic digestion of vegetable wastes. Based on these observations further studies are in progress in continuous reactors for various loading ranges. (R.A.2, 2012)

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Sustainable energy policy for sustainable development

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Abstract: This article is based on the context, necessity, reviews implementation and recommendation of sustainable energy policies practice in and outside of Nepal. Here is the discussion about the transition to sustainable energy from present energy context. The policies adopted in Turkey, Morocco and Algeria are seen appropriate to sustainable energy development. It is important to point out the restructuring policies that are directing the development of new and renewable energy, and giving special emphasis to socio-economical bodies, laws and legal regulations. Article also discuss about the barriers and difficulties of development of renewable energy of country.

Key words: Policy, Sustainable Development, Sustainable Energy, Renewable energy, Transition, Law and regulation

1. INTRODUCTION

Due to population growth, rapid urbanization and industrial development, the demand of energy is growing every year. The main sources of energy in the world are fossil fuel, Nuclear energy, Solar, wind, biomass and hydropower. Energy is categories in two types as renewable or sustainable and non renewable energy according to their reversibility. Sustainable energy is clean and can be used over a long period of time. Unlike fossil fuels that most countries are using, renewable energy only produces little or even no pollution. The most common types of renewable energy in US are hydroelectric, solar and wind energy; solar energy are commonly used on public parking meter, street lights and the roof of buildings. Fossil fuel, nuclear energy etc. are non renewable energy due to their irreversible property i.e. once they are used cannot be regain. Non renewable energy is in limited quantity in the earth. One day in future the amount of non renewable energy will be finished or not enough to meet the demand so these are unsustainable. Up to this time there is no option for the use of renewable energy for sustainable development. Today, large battles are to be undertaken during the century for the survival of the planet: include energy efficiency as a priority in international politics, reduce emissions of greenhouse gases, save energy for economic development and reducing inequalities, empower stakeholders, strengthen the global regulation(A. Ghezloun, 2015). So to mitigate the future energy crisis many European countries has adopted the sustainable energy policy.

It is important to point out the restructuring policies that are directing the development of new and renewable energy, and giving special emphasis to socio-economical bodies, laws and legal regulations. In this respect, particular attention and priority should be given to the development of the hydroelectric potential in Turkey, since it is the most important natural renewable resource and only 35% of the technically and economically utilizable hydro potential has been developed so far(Yuksel, 2015).

2.Nepalese Energy Context and Necessity

Utilization of energy source in Nepal is in infancy stage. Although country has tremendous capacity of renewable energy like hydropower, solar power, wind energy biomass but the country is highly dependent on fossil fuels which are imported from India. Except safa tempo running inside capital's road almost transportation, agricultural, and industrial sectors are operated from fossil fuel like petrol, diesel, or coal. Due to the high dependence in fossil fuel Nepal has to face artificial fuel crisis in the name of blockage prior to natural (actual) energy shortage. Nepal total hydropower resources are estimated at 83,000MW of which about 42,000 MW can be economically tapped. (Energy to move rural out of poverty:The rural energy development programme model in Nepal, 2012).Whereas the generations and supply of the same is lagging far behind because of various reasons resulting in longer hours of power-cuts. For the last six years, The Government of Nepal (GoN) has made numerous efforts to address the issues of load –shedding and to reduce the supply-demand gaps of electricity. However, the significant improvement in the situations is yet to be seen and an innovative and different approach rather than conventional one is felt necessary(AEPC). For the sustainable development and independence Nation should take a strong step to develop and implement the sustainable energy policy.

To promote the sustainable energy Nepal has taken the initiation as the establishment of the energy institution name as "Alternative Energy Promotion Centre (AEPC)" under the ministry of Energy. Recently government has adopted the installation of solar for every new house in urban area as mandatory rule. Government, Banks, Donor agencies etc have attractive schemes and offer for the promotion of solar energy. Besides these use of renewable energy is always the second choice of consumers. In rural areas micro hydropower plants are ignored by consumers. The main problems are due to:

- High cost of renewable energy Technology
- Periodic maintenances
- Inaccessibility of technology, equipment or accessories
- Lack of skilled manpower
- Low financing and least priority by government
- Dominance by hydro potential from mega projects
- Energy Investors are not feeling secure to compete with large hydro projects which are assumed to be installed in future.

Once the economy starts declining it will not be able to afford transition to a more expensive energy system and transition would only accelerate(Ziyi Wang, 2015). To mitigate above problems government should launch a powerful energy policy from national level.

3. World's Practice

Moroccan Policy:

As part of its energy strategy, Morocco gives priority to the development of renewable energy and to the sustainable development. The Moroccan Law on Renewable Energy aims to promote energy production from renewable sources, its marketing and its export by public or private entities. The Law of Energy Efficiency aims to integrate energy efficiency techniques in a sustainable manner. It is created under Law No. 57-09 "a Moroccan Agency for Solar Energy" aimed to achieve a development program of integrated projects for generating electricity from solar energy, with a minimum total capacity of 2000 MW (A. Ghezloun, 2015).

Main features of Moroccan Energy Policy:

- Open competition for production of electricity from Renewable sources.
- Electricity produced from Renewable sources can be connected to national grid line in 3 medium (Medium, High & Extra High Voltage)

Projects running under this policy in Morocco:

- 5 sites for 2000MW by 2020 (increase share of total electricity by14% and prevent 3.7 million ton CO_2/year)
- 1.7 sq m of Solar thermal collector by 2020 (prevent 920,000 ton CO_2/year and creates 920 permanent jobs)
  Potential s for investment for renewable Energies in Turkey? (Yuksel, 2015)

- 2000 MW from Wind by 2020 (share 14% of total electrical energy) (A. Ghezloun, 2015)

Algerian Energy Strategy:

- The producer of electricity from Solar PV & thermal, wind, geothermal, waste recovery small hydraulic or biomass may benefit premiums through sale of guaranteed purchase rate.
- Legal strategy:
  Law on energy management
  Law on electricity and gas distribution by pipe line
  Law on promotion of RE in context of Sustainable Development

Projects:

- Ambitious program to develop Renewable Energy (RE) like installing up to 22000

MW between 2011-2030 (12,000 MW for domestic, 10,000 MW for export)

- It is expected that 40% of electricity for domestic consumption will be from RE by 2030 (Solar 37%, Wind 3%)
- National program adopted by government includes realization of 27 PV power plants, 27 diesel hybrid and gas turbine 6 solar thermal plant and 7 wind farms. (A. Ghezloun, 2015)

Water management for development of water potential in Turkey

Turkish Electricity Transmission Company (TEIAS) has prepared the Long-Term Energy Generation Plan, taking into consideration the MAED model, demand outcome. According to the Plan, the installed capacity will increase 57,551 MW in 2010 and to 117,240 MW in 2020. The installed hydropower capacity is anticipated to increase to 18,943 MW in 2010 and to 34,092 MW in 2020. Thus, an additional 1000 MW of hydro capacity should be added to the system annually over the next 20 years. Turkey is thus seeking support for the development all its economic potential by 2023, which is the 100th anniversary of the foundation of the Turkish Republic(Yuksel, 2015)

Sectors	Million e	Remarks
Hydroelectric	114	Economical development potential of 28,600 MW, corresponding 100,000 GWh/a
Wind power	57	Economical development potential of 48,000 MW with wind speed >7 m/s
Solar Thermal	165	Economical development potential of 131,000 GWh/a, corresponding to approx. 300 million sq mcollector area
Biogas	4	Agricultural residual material and dung, when used for electricity generation, 1000 MWe and 7000 GWh/a
Total	340	

4.Conclusion And Recommendations:

There is need for all stakeholders (policy makers, energy industry executives, etc.) to work together in order to expedite the development of sustainable energy systems. . Some areas of focus and possible collaboration by the various stakeholders include:

- Defining a predictable and coherent energy policy.
- Implementing stable regulatory and legal framework to support long term investment.
- Encouraging public and private initiative that enable innovation and foster research. (Edomah, 2016)

For the Nepalese context sustainability in energy should be find out from renewable energy sources. Due to the high potential from water country should make easier water policy for production of energy. Due to the lack of suitable policy Nepal is unable to produce electricity from its sources. We all know Nepal is poor and cannot afford mega projects investment by cash. For this we should make a fast track implementation policy for mega projects to attract the energy investor.
While developing energy policy government should give special attention to consumption sector and availability renewable energy sources. Like industrial and transportation sector which consume highly concentrated energy can be benefited from mega hydro projects, while residential sector can utilize combine energy from solar and hydroelectricity. If we look domestic energy consumption pattern high demand of energy is used for cooking and heating. To replace imported LPG gas we should make policy for the commercial supply of biogas, use of efficient electric oven and solar heating system in urban areas. For rural areas it is recommended to make policy to promote biomass energy like firewood, Improved Cooking stove (ICS), wind mill, or micro hydro.
The policy can be make based on geography, weather, climate latitude (especially for solar).

The world will either slowly run out of fossil fuels or exceed the capacity of environment to absorb the products of their combustion. The uneven distribution of resources will cause global conflicts over the remaining reserves, or they will become unaffordable. The renewable energy sources, will determine the inevitable transitions in energy use and the future of our civilization. Energy policy should encourage the introduction of hybrid possibilities and support other forms, including electricity generation by the private sector to share the heavy burden on her. (A. Ghezloun, 2015).

Water and energy are the two important engines of sustainable development. In the energy sector, the basic policy of Turkey is the provision of cheap electrical energy on time and in sufficient quality and quantity (Yuksel, 2015). For the water energy context Nepal is similar to Turkey but Nepalese recent policies are very different than Turkey. Investments in hydropower deserve special support as they are clean and have a long economic lifespan. There are several outstanding challenges which constitute the basis for future action. All of these need to be overcome by developing this precious resource in an equitable, reasonable and optimal way.

It is important to point out the restructuring policies that are directing the development of new and renewable energy, and giving special emphasis to socio-economical bodies, laws and legal regulations.

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Smart City: A Driving Factor for Transforming City to a Sustainable Future

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Abstract: Cities represent three quarters of energy consumption and 80% of CO2 emissions worldwide, and represent the largest of any environmental policy challenge. Cities house half the world's population today but are set to host three quarters in 2050. To cope with this continued urban growth we will need to invent new ways to manage cities and make them more effective. The convergence between digital technology and the world of energy, will pave the way for a new ecosystem of services which will enable both a better quality of life and reduced energy consumption. The term 'Smart City' has emerged for a growing audience across a broad range of disciplines as the concept expands to address multiple challenges and opportunities in sustainable development. This article addresses the positive impact of Smart Cities to the people and the society as a whole by integrating Information and communication technology (ICT) with the city's infrastructure. This article also further assesses the impact of Smart cities in various social, economic and environmental factors with few examples of the Smart cities initiatives around the world.

Key words: Smart cities, urban sustainability, information and communication technology (ICT)

Introduction

Over half of the world's population now lives in urban areas. By 2050 this will have risen to 70%. In the industrialized world, cities are bursting at the seams, struggling to meet the needs of their citizens. Creaking, outdated infrastructure, cars clogging up the roads, and buildings that are literally leaking energy not exactly the picture of urban health. Add to this inadequate public transport, a shortage of green spaces, landfill sites overflowing and it's enough to make you run for the (greener) hills. The situation is even worse in parts of the developing world, with the poorest countries least equipped to invest in the basic urban infrastructure water, sanitation, housing that is needed to cope with rapidly growing urban populations. (Salterbaxter, 2010)

Densities of urban areas provide opportunities to increase efficiencies and reduce demands on resources with a focus on smart planning of the urban environment. According to the Guide to Greening Cities, people who live in dense urban environments produce fewer emissions than those living in suburbs.

A smart city is a urban development vision to integrate multiple information and communication technology (ICT) solutions in a secure fashion to manage a city's assets – the city's assets include, but not limited to, local departments information systems, schools, libraries, transportation systems, hospitals, power plants, law enforcement, and other community services.

Green practices allow city leaders and partners to reduce health, environmental and financial risks and promote sustainable economic development; including local green businesses and jobs. Components of 'smart' practices can include (but not limited to) building retrofits, green infrastructure or low impact development (LID), clean fleets, waste reduction and material reuse. (Riga, 2013)

Many cities have discovered the business case for sustainable practices and are taking steps now to incorporate smart practices. With the help of federal programs, utility companies, foundations, businesses; cities have a multitude of financing options available to minimize financial barriers to implementing 'smart' practices.

For instance, Los Angeles creatively leveraged EECBG funds to reduce energy consumption in public buildings, multi-family affordable housing and commercial buildings. As of July, 2012 Los Angeles is also saving more than $ 3.8 million a year and reduced their energy use by 61% by converting 92,000 streetlights into LED lights -- the equivalent to 25,000+ tons of greenhouse gas emissions per year. (Riga, 2013)

Cities will require transformations in applications and governmental frameworks, incorporating all of the components into the big picture to fully become ‘smart. There is a search for the “thread” that connects innovations that have the potential to be transformational in different sectors, from energy and water to buildings and transportation.”

Successful development of a smart city will require the combining of a bottom-up systems approach with a top-down service development and a data-centric approach. Technology integration includes vertical integration from sensors, to low cost communication, real time analysis and control, and horizontal integration of historically isolated systems up to citizen-based services. Combined, this creates a system of systems. (Commision, 2014)

Extending the Internet to create smart cities

Growing cities increase complexity

The megatrend of urbanization will dramatically shape not only cities, but the entire world. Urbanization has created a pressing need for infrastructure investment, regardless of budget limitations and austerity programs. Cities must have functioning traffic systems, intelligent logistics, efficient energy supplies, and environmentally compatible buildings. Studies suggest that cities are investing on average €2 trillion a year. But managing growing cities with decreasing budgets and increasing complexity, along with the expectation of a higher quality of life places heavy demands on both infrastructure and environment. The megatrends urbanization, demographic change and climate change will shape the future. City managers need to respond to these megatrends to make critical decisions about infrastructure today that will meet future demand. (Siemens AG, 2013)

Today, the quality of air and water, the movement of people and objects, the changes in weather, the road traffic, the production and consumption of energy, can be measured by sensors, and tracked and interconnected through networks in real time. It is through interconnecting buildings, factories, vehicles, power generation plants, lighting, that cities will be "smart".

Empowering people in Smart cities

In the same way that the IT revolution has been driven by consumer needs, so too will the energy revolution. As blogs, social networks and video platforms have enabled people to produce information and customize their content, new technologies will make possible energy self-production and customization of energy usages and consumption.

Smart cities will also enable the use of open data which will create new urban services such as better transport connections, accident risk warnings and home monitoring for part-time and full-time careers. Local councils will have greater responsibility for ensuring the collection and the public availability of this data.

Integrating Technology and Government for Transforming City Infrastructure

Rather than being an expense, smart technology integration can create considerable opportunities for added value in any city. As urban populations continue to rise, cities will face unprecedented infrastructure demands, and improved public private coordination is needed for better management of energy, water, transport, buildings and other urban infrastructures.

A variety of tools are available for strategic investments, smart policies and breakthrough technological innovations to enable cities to better respond to increasingly complex urban planning, design, technology and development challenges. (Riga, 2013).

Emerging information and communication technologies (ICT) integrated and enabled through the development of smart electricity grids can help reduce demand for electricity, manage loads and help make cities more efficient. The information and communications technology revolution is making the connections not just possible, but real.

A Variety of impacts of Smart cities

Technology integration helps cities to improve efficiency, enhance their economic potential, reduce costs, and open the door to new business and services, and improve the living conditions of its citizens. A key condition for value creation through integration is the compatibility of technologies; which is best achieved through common and consensus-based standards that ensure interoperability. Presently, however, smart city projects concentrate mainly on vertical integration within existing independent infrastructure and services silos, e.g. energy, transport, water or health. A truly “smart” city requires horizontal integration as well as creating a system of systems capable of achieving considerable increases in efficiency and generating new opportunities for the city and its citizens. (Commision, 2014)

Apart from various impacts of Smart cities, the sustainability impacts on the major three sectors are discussed below:

Construct or invent a new economic model (the economic factor): Smart Cities provide citizens with the capacity to develop their economic potential, and attract business and capital.

With the global financial crisis, the economic sustainability of cities has taken centre stage. The crisis has unearthed considerable weaknesses in the financial models and planning strategies of public authorities in the provision of services and in their infrastructure investments. Their financial sustainability now depends also on new financial models, as well as more efficient and better-integrated services and infrastructures. (Commision, 2014)

One well-known example within this field is placing light sensors at lampposts, so that lighting is switched on/off depending on the level of daylight, or even when someone passes by through the street. Not only is this an improvement in terms of efficiency, but also in terms of economic benefit. Other example could be the case in Masdar, where the driving idea was to change the oil-based business model of Abu Dhabi Emirates to one based on renewable and alternative energy sources.

Reduce energy consumption (the eco-sustainability factor): Cities face a number of environmental sustainability challenges, generated by the city itself or caused by weather or geological events. Eco city reduce the impact of the city on the environment resource to promote the efficient and intelligent deployment of technology and to integrate infrastructures. Eco cities are developed in such a manner as to increase the resilience of the city to environmental shocks. These three pillars have one common denominator, namely the need to achieve more and better with less efficiency. Efficiency is achieved in a manner that brings benefits and opportunities to citizens, making the city more dynamic and participatory. (Commision, 2014)

One well-known example within this field is placing light sensors at lampposts, so that lighting is switched on/off depending on the level of daylight, or even when someone passes by through the street. Another classic example is the collection of garbage: having sensorized all garbage containers with volume sensors, allows calculating the most efficient route to pick up trash wherever necessary. Not only is this an improvement in terms of efficiency, but also in terms of citizens’ perception, since containers never get to be filled to capacity as the garbage truck passes as soon as it is needed. The best example of this is the Amsterdam Smart City project, where reducing energy consumption and more efficient energy usage were the key motivations for the project.

Improve the quality of life in a city environment (the social factor): A city’s attractiveness for people, business and capital is closely related to the quality of life (QoL), business opportunities and security and stability, which are guaranteed by social inclusiveness.

This is best exemplified by the Suwon Smart City project where the initial goal was to improve the lives and education of citizens, and improve government services. (Salterbaxter, 2010)

These three drivers are not mutually exclusive. They are all major reasons behind the establishment of Smart Cities, and they can all be found playing a role in the initiation of a project. They do not exclude that in a specific Smart City context another driver may be present, but considered less important. In fact, the Alcatel-Lucent analysis revealed aspects of different drivers in each Smart City project. (Lucent, 2012)

Conclusion

Effectively utilizing science and technology requires more than just expanding technical knowledge and tools. Supportive and coordinated governmental frameworks are needed to provide accompanying social, economic and policy innovations. Successful public private partnerships are taking place and can lead to transformational change; however, additional models, pilot projects and data are needed to scale up new frameworks for smart cities.

The approach of smart cities is to improve resource management by adding connectivity and intelligence within existing. Therefore, Smart cities are sustainable, resilient and efficient. Sustainability is about interweaving economic, social and environmental elements to develop holistic and adaptive policy processes; thus creating more resilient communities. Sustainability is about long-term prosperity, and resiliency is about the ability to adapt to change – they go hand-in-hand.

Smart city is the need of future world to cope up with the increase urbanization and high demand of energy in a part and the depletion of natural resources and hiking price of the energy on the other part. Therefore, Smart city can be a better solution on transforming the city to a sustainable better future

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Enhancing Rural Energy Scenario of Nepal through integrated Renewable Energy technology

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Abstract: This paper aims enhancing rural energy scenario of Nepal through the integrated renewable energy technology thereby replacing the existing conventional, unprocessed traditional energy being used. Traditional solid biomass is still being used extensively, contributing to 87% of the energy demand thereby causing negative impacts in human health and environment as well. There is considerable disparity in electricity distribution and consumption patterns between rural and urban areas, as the benefits of electrification are largely concentrated to urban areas. Due to the uncertainty in the availability of renewable energy resources, it is preferable to use an integrated renewable energy (IRE) system to increase system reliability. Despite of having abundant renewable energy resources in the rural areas, the most of the rural area is still deprived of the clean energy.

Key words: Renewable Energy, Nepal, Rural areas

Introduction

Energy is the most fundamental need for the socio- economic development. Energy has been in use since very ancient time in different forms and through various sources. The provision of affordable and reliable energy service is considered elementary for sustainable development. The majority of the non-electrified rural communities in developing countries (more than 2.4 billion people) relies on non-refined or unprocessed traditional energy sources including firewood, agricultural residues, animal dung and charcoal to meet their daily energy demands for cooking, heating and lighting. Until 2030, around 2.7 billion of the poor rural commuities in developing countries are believed to continue using traditional biomass energy sources to meet their energy demand (WEO, 2006; Zahnd and Kimber, 2009).The use of traditional unprocessed energy sources can cause serious health hazards in human health. For instance, burning of traditional unprocessed solid biomass in poorly functioning stoves is recognized as one of the major drivers of indoor air pollution in developing countries (Bruce et al., 2000; Fullerton et al., 2008; Malla et al., 2011; Warwick and Doig, 2004). The long-term exposure to indoor air pollution is associated with increased risk of respiratory and other health problems including acute respiratory infections (ARI), chronic obstructive pulmonary disease (COPD), lung cancer, tuberculosis and

Asthma, especially in women and children under the age of 5 years (Bruce et al., 2000; Smith, 2002; Smith et al., 2004). Indoor air pollution has an important global impact on human morbidity and mortality where biomass fuel smoke exposure is responsible for 1.6 million deaths per year and 2.7% of the global burden of diseases annually (Fullerton et al., 2008; WEO, 2006; WHO, 2006). Therefore, least developed countries like Nepal require considerable effort to provide affordable and reliable energy access to its rural communities (Sapkota et al., 2013).There is significant disparity in access to electricity amid rural and the urban areas of the developing countries. The rural areas are deprived of grid electricity due to the geographical complexities. . Rural communities in Nepal spend more than one third of their household expenditure on energy services. Moreover, they devote a large portion of their time to energy related activities, with women and young girls spending more than 6 h a day gathering wood and water, cooking, and processing agricultural products. Access to modern energy services can therefore make a real difference to the lives of people in rural communities in Nepal (UNDP 2005).There is considerable disparity in electricity distribution and consumption patterns between rural and urban areas, as the benefits of electrification are largely concentrated to urban areas . Consequently, only 34% of the rural population had access to electricity in 2008 where contrastingly, 90% of the urban population had access to electricity during the same year (Nepal, 2012).

Integration of locally available renewable energy resources can contribute a lot in enhancing clean energy in the rural areas. Due to the uncertainty in the availability of renewable energy resources, it is preferable to use an integrated renewable energy (IRE) system to increase system reliability. An IRE system utilizes two or more locally available renewable energy based systems and may be a cost effective solution to meet the energy demand of remote areas. Further, such IRE systems are non-polluting, reliable and reduce the total operating and maintenance cost. In order to utilize the available renewable energy resources efficiently and economically. The optimization of integrated renewable energy systems helps reducing unit cost of energy. An optimal IRE model comprising Micro hydro, Solar PV, Wind energy, Biomass, Biogas etc can be generated according to the local availability

Methods

This paper aims enhancing rural energy scenario of Nepal through the integrated renewable energy technology thereby replacing the existing conventional, unprocessed traditional energy being used in the rural areas. However, the modeling of an IRE system is a very complex task which requires the development of mathematical models for each component. To develop an integrated RE technology , there comes a need to case study a remote village of Nepal which is based on the traditional energy sources. The objective of the study would be to minimize the total cost of generation and cost of energy of IRE for the proposed study area .After a selection of particular remote area for case study, the total energy demand of all the sectors in the area is to be estimated on the basis of the number of households and population of the villages. Seasonal load demand is also to be determined for different load sectors such as domestic load (lighting, TV, fan and radio/music system), community (primary health center, street lights and school lighting), commercial (lighting for shops and flour mill) and small scale industrial load (saw mill or paddy huller). The estimation of total energy requirement of the study area is to be made on the basis of minimum desirable seasonal load profile and hourly load. The annual energy generation can be calculated using mathematical modeling techniques and annual capacity factor defined by actual generated energy in kWh/yr to the maximum generated energy in kWh/yr. The total annual load can be synthesized through HOMER software based on estimated value of seasonal hourly load.

In order to assess the potential of renewable energy resources, an extensive survey is to be done to collect the information regarding the availability of biomass, solar irradiation, micro hydro and wind speed. The potential assessment of solar photovoltaic (SPV), micro hydro generator (MHG), biogas generator (BGG), biomass generator (BMG), and wind turbine generator (WTG) is to made as per the available standard methodology.(A.Chauhan 2014).Mathematical modeling is to be used to find out the approx. potential of particular renewable energy. Optimization results in terms of optimum total generation cost and cost of energy considered can be obtained through Genetic Algorithm based approach relating with various OPF(Optimization Power Factor) values. Furthermore, deficit energy and corresponding CIC(customer interruption cost) can be computed for different OPF values.

Results

The renewable energy potential of Nepal is estimated to be about 50 MW electricity from micro hydropower schemes, 2100 MW from solar and 3000 MW from wind (SWERA, 2006; WECS, 2010). Moreover, the country has the capacity to develop about 1.1 million domestic biogas plants (SREP, 2011; WECS, 2010). Traditional solid biomass burning stoves have a low heating efficiency of 5–10% compared to that of the Improved Cooking Stove (ICS) (25–30%) (Barnes and Floor, 1996; Pokharel, 2003). Apart from efficiency, use of an ICS can reduce firewood consumption by 50% and indoor air pollution by 80% (AEPC/ESAP, 2012; Sapkota et al., 2012). . It has been estimated that approximately 420 t of biomass per year has been saved by the use of ICSs which is equivalent to 262 ha of forest area (AEPC/ESAP, 2012; Sapkota et al., 2012). Adoption of ICS technology can achieve green house gas (GHG) emission reduction (ER) by 1.2 t CO2 equiv/plant/year and has a carbon mitigation potential of 8.34%. (Sapkota et al., 2013). Use of biogas in rural household can save about 14,268 t of biomass per year which is equivalent to 8,917 ha of forest area (Sapkota et al., 2012). Biogas technology has the highest (78%) carbon mitigation potential and can achieve GHG ER by 2.3 t CO2 equiv/plant/year (Bajgain et al., 2005; Sapkota et al., 2012). Certified emission reduction (CER) from solar PV and micro hydro scheme is estimated to be 0.22 t CO2 equiv/year/ plant and 2.3 t CO2 equiv/year/plant, respectively (Sapkota et al., 2012).

However this article itself is not a research based article, the results of the integrated renewable technology in rural areas is referenced through the other research based journal articles. Based on the genetic algorithm approach, unit cost of energy in four different zones of Chamarajanagar district of Karnatak state India has been computed for OPF value 1.0 and results for zone 1, zone 2, zone 3 and zone 4 were found as Rs 4.09/kWh, Rs 4.50/kWh, Rs 3.91/ kWh and Rs 4.26/kWh respectively. (Saini S. R., 2016) . The integrated model will only be feasible if its OPF value lies in between 1 & 0.8 .And if the OPF value lies below 0.8 the model doesn't seem to be feasible. (Saini S. R., 2016) . . It has been observed from Fig. 6 that the IRE model is capable of supplying energy up to 80% of the load as long as the OPF value is 0.8. For OPF value less than 0.8, the system becomes infeasible due to the unavailability/non-functioning of resources. Hence the cost of generation is increased. Therefore, it is concluded that, deficit in energy increases with an increase in customer interruption cost and the proposed IRE model is found to be unfeasible for OPF value below 0.8. (Saini S. R., 2016)

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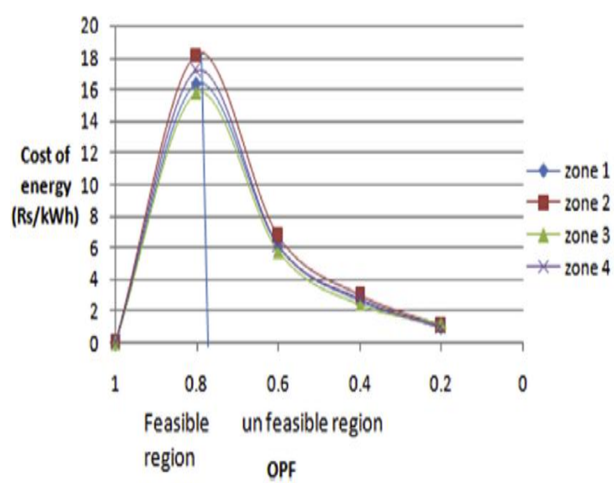

Fig. 7. Variation in optimal cost of energy with OPF value for different zones.

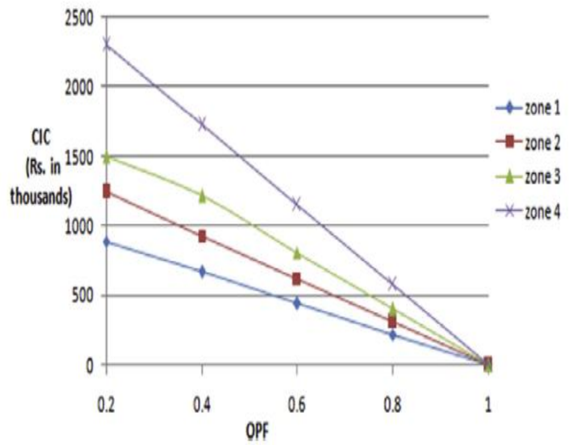

Fig. 9. Variation in customer interruption cost with OPF value for different zones.

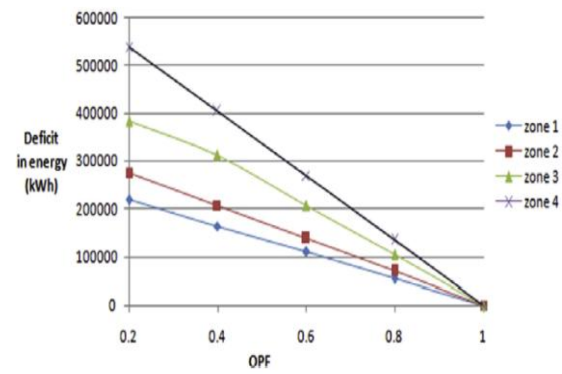

Fig. 8. Variation in deficit in energy with OPF value for different zones.

Conclusion

Despite of having abundant renewable energy resources in the rural areas of Nepal, the area is still heavily dependent on the traditional unprocessed sources of energy thereby degrading both the human health and environment. The GoN has set up the far-sighted goal to increase the share of renewable energy from less than 1% to 10% and to increase the access to electricity through RETs from 10% to 30% by 2020 (SREP, 2011). In order to achieve its long term vision, the GoN has planned to invest US$1076 million in RETs sector of which US $115 million will be allocated to hydropower (mini/micro and pico), US$333 million for solar home systems and US$135 million for biogas by 2020 (MOEST, 2009). Considering the country's poor financial condition, persistent energy shortage and frequent power outages, Nepal has been in consideration for assistance under the Scaling Up Renewable Energy Program (SREP) in Low Income Countries (CIF, 2013). The GoN will be allocating a fund US$40 million from the SRE.

Beyond all these initiatives the renewable energy sector of Nepal is still lagging back .One of the reasons for this backwardness may be due to the fact that energy sector in Nepal is driven by the centralized decision making system which lacks transparency and often subjects to lengthy bureaucratic hurdles (Nepal, 2012). Lack of experience, inadequate networking between energy companies/distributors of renewable energy systems and micro-finance institutes, and inadequate cooperation between different renewable energy projects/programs are also impeding the installation of RETs in rural area. Moreover, RETs are being promoted without examining its target and end users (Karki et al., 2010).As most of the rural areas of Nepal are economically not sound thereby causing low purchasing power of rural peoples, so the private sector is not so interested in investing RET in rural technology. Lack of technical capacity is another fundamental factor to impede the development of RETs in Nepal. Given the country's fluid economic condition, it cannot afford to finance RETs and invest in R&D (Nepal, 2012).

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