Lecture 13 - List of technologies for adaptation and mitigation of climate change for selected sectors

Dec 2016

Temperature

- There is general agreement that average temperatures in Nepal increased at an annual rate of 0.06°C between 1977 and 2000, with a 0.04°C increase in the Terai and 0.08°C increase in the Himalayas (NAPA, 2010).
- Warming patterns have been most pronounced at higher altitudes and more so during the winter months as opposed to the monsoon season (Oxfam, 2009). Warming has also been greater in the western half of the country than in the eastern half.

Synnoth., P., 2012, Climate change, agriculture, & food security in Nepal.

Precipitation and water availability

1) The Western half of Nepal is considerably drier than the eastern half;
2) Regions that receive less average rainfall have shown a higher degree of warming;
3) The timing of monsoon, when Nepal receives 75-80 percent of its annual rainfall, has become increasingly unpredictable (Chhetri et. Al., 2012)

Although the effects of rainfall variation tend to be site-specific, delayed onset of monsoon pushes back plantation and typically has an adverse impact on crop yields (Altieri).

Synnoth., P., 2012, Climate change, agriculture, & food security in Nepal.

Other effects of climate change in Nepal

- Establishment and spread of pests and diseases into new geographical areas. Higher temperatures speed up the lifecycle of some pests and disease vector insects so that populations grow faster.
- This spread of plant pests can negatively affect crops and the availability of food of appropriate quality by increasing production volatility.
- Biodiversity loss is also occurring and is expected to continue if the effects of climate change intensify.
  - Since different plant and animal species are suitable to specific ecosystems, changes in soil, temperature, humidity, sunshine, and water availability will alter a particular specie's ability to survive in its environment.
  - Additionally modern and hybrid seed varieties are increasingly replacing local traditional varieties as they often provide greater drought resistance or higher yields.
  - Cold-water fish, herbs, pasture land, apple trees and livestock are expected to be most at risk in Nepal (Malla, 2008).

Synnoth., P., 2012, Climate change, agriculture, & food security in Nepal.

TABLE 1. Anticipated climate change impacts in Nepal.

Temperature	• Significant rise in temperature: ➢ 0.5 to 2.0 °C by 2030 ➢ 1.3 to 3.8 °C by 2060 ➢ 1.8 to 5.8 °C by 2090 • Increase in the number of days and nights considered hot by current climate standards • Highest temperature increases during the months of June to August and at higher elevations
Precipitation	• Wide range of mean annual precipitation changes: ➢ -34 to +22% by the 2030s ➢ -36 to +67% by the 2060s ➢ -43 to 80% by the 2090s • Increase in monsoon rainfall towards the end of the century: ➢ -14 to 40% by the 2030s ➢ -40 to +143% by the 2060s ➢ -52 to +135% by the 2090s
Runoff	• Higher downstream flows in the short term, but lower downstream flows in the long term due to retreating glaciers and snowmelt and ice-melt • Shift from snow to rain in winter months • Increased extreme events, including floods, droughts and GLOFs

Source: Figures for anticipated changes in temperature and precipitation (NCVST 2009; McSweeney et al. 2008); figures for runoff (Bates et al. 2008; Eriksson et al. 2009).

http://www.iwmi.cgiar.org/Publications/Working_Papers/working/WOR139.pdf?galog=no

Types of disaster

- Rapid onset disasters (unpredictable): cyclones, windstorms, landslides, avalanches and floods.
- Slow onset: drought, rising temperature, forest fires, snow melt, regional sedimentation.

Flooding

- It damages crops and property and often results in epidemics. The poor are most vulnerable to its effects.
- Types of floods:
  - The glacier lake outburst flood (GLOF)
  - Bishyari (It is a flood that occurs when a landslide which dams a river is bleached by the reservoir of water which forms upstream of it). They commonly occur in the mid-hills after a cloudburst. It occurs randomly. (for example; a massive landslide blocked Sunkoshi River at Mankha VDC in Sindhupalchowk district on Saturday morning, August 2, 2014).
- If the monsoon pattern alters due to climate change, much of the Ganga basin in India and Nepal would face consequences like failure of urban food supply, transport, communication, energy, health, water management & institutional system of local population.

Aridity and drought

- Aridity (extremely dry) and drought: slow onset widespread disaster
- Variability of rainfall regimes suggest that agriculture in Nepal will face immense challenges as seasonal drought increases.
- As the food production decreases the dependency on import of food increases on the condition of global market.
- The use of spring and other local water resources (for drinking water) could be seriously affected by the erratic rainfall; i.e., changes in rainfall pattern.

Forest fires

- Community forest: success story of promoting livestock rearing and increasing milk production
- Increasing forest cover is a key mechanism for promoting cost-effective carbon banking which mitigates greenhouse gas emissions while providing local population with an array of products that help them adapt to climate change.
- An increase in the frequency and intensity of droughts if coupled with extended forest cover, will greatly increase the risk of forest fires.
  - These fires have a negative impact locally and potential major implication for glacier and snow melt at higher elevations.
  - It also accelerates the regional sedimentation and changes river courses.
  - The indirect long-term impact is difficulty in establishing seedlings after a fire. It will take long time for villagers to gather non-timber forest products. That is; the loss of forest implies loss of local livelihood.

Adaptation policies

- **Food**
  - Strengthening local agriculture
  - Importing food from regional market
- **Forestry**
  - Reforestation
  - REDD (reduce emissions from deforestation and forest degradation)
- **Migration (remittances)**
  - Seasonal: working in India for a short-period, moving from mountain to hilly or plain land during winter
  - Long-term: working abroad (domestic skill and expertise decline)
- Micro-credit or loans can help farmers cultivate drought or flood-resistant species and increase crop variety.

Climate change policy of Nepal

- The adverse impacts of climate change have been noticed in agriculture and food security, water resources, forests and biodiversity, health, tourism and infrastructures.
- Climate-induced disasters and other effects have caused damages and losses to life, property, and livelihoods.
- Nepal has considered climate adaptation as a national agenda.

Sectoral vulnerability to climate change

S.N.	Climate change impacts	Vulnerable sectors	
1	Increased temperature	• Agriculture and food security • Forestry • Ecology and biodiversity • Water resources	• Urban settlements and infrastructure • Energy • Public health
2	Change in rainfall pattern	• Agriculture and food security • Water resources	• Public health • Climate induced disaster
3	Food, water loss and erosion	• Agriculture • Forestry • Ecology and biodiversity • Water resources	• Energy • Transportation • infrastructure
4	Reduced precipitation	• Agriculture • Forestry • Ecology and biodiversity	• Energy (hydropower) • Public health

Sectors for adaptation assessment

The report on Vulnerability, Impact and Adaptation Assessment has identified 6 sectors:

- Agriculture
- Water resources
- Forestry and biodiversity
- Public health
- Climate induced disaster and
- Human settlement and infrastructure

Sectors/ sub-sectors for adaptation assessment

S.N.	Sector	Sub-sector	
1	Health	Diarrhoeal diseases (DD)	Vector borne disease (VBD)
		Respiratory diseases such as acute respiratory infection (RD)	Extreme weather condition related diseases – heat stress and cold stress (EWRD)
		Malnutrition (MN)	
2	Water resources	Irrigation(IR)	Water supply, sanitation and hygiene (WSSH)
		Hydropower development (HD)	Decision support system for river basins (DSSRB)
		Water induced disasters (WID)	
3	Agriculture	Awareness raising (AR)	Land and water conservation (LWC)
		Bio-resource management (BRM)	Reforestation and afforestation (RF & AF)
			Livelihood/farming system diversification (L/FSD)

Sectors/ sub-sectors for adaptation assessment

S.N.	Sector	Sub-sector
4	Forest and biodiversity	
5	Urban settlement and infrastructure	
6	Climate induced disasters	

List of technologies identified for TNA – Adaptation

Sector	Sub-sector	Technology
Health	Diarrhoeal disease	Drinking water quality surveillance (DWQS)
		Health care liquid waste management (HCLWM)
		Water, sanitation and hygiene (WASH)
	Vector borne disease	Mosquito nets (bed nets)
		Bacillus thuringiensis israelensis (Bti) [mosquito larvae killer]

List of technologies identified for TNA – Adaptation

Sector	Sub-sector	Technology
Water resources	Irrigation	Bore hole/ Tube well irrigation system management
		Sprinkler Irrigation system
		Water leakage management
	Water induced hazards	Flood forecasting and warning
		Bio-engineering technique
		Use of permeable spurs

List of technologies identified for TNA – Adaptation

Sector	Sub-sector	Technology
Agriculture	Resource management	Integrated farming system (mixing of diverse components (different crops and animals) in the farm)
		Conservation agriculture (minimum tillage)
		Biochar
	Niche based farming	Organic nutrient management
		Cultivation of stress tolerant crop/ varieties
		Mixed cropping

Adaptation approach in Nepal to minimize the climate change

Specific adaptation approaches include:

- Citizens are made aware of diarrhoeal disease, vector borne disease and use of water, sanitation and hygiene (WASH) for healthy living
- Diversifying crops to adjust to changing temperature and precipitation patterns
- Adopting water and soil moisture conservation measures that minimize the impact of potential seasonal water shortages
- Changing livestock breeding practices and shifting grazing patterns
- Developing and using disease-resistant crop and livestock species

Energy consumption in Nepal

http://mof.gov.np/uploads/document/file/Economic%20Survey%202015-16%20-%20English_20160812062624.pdf

Energy Consumption

10.27 Traditional sources of energy still hold majority when it comes to the necessity and supply of energy. Despite several efforts made towards using renewable energy, traditional energy consumption rate is still high. Likewise, though sources of renewable energy mainly hydropower and solar energy have enormous potentials; energy crisis has continue to grow for failing to capitalize those resources.

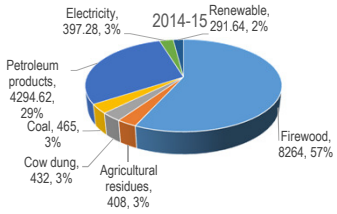
Table 10(a): Energy Consumption Status

(In ToE: Tons of Oil Equivalent)

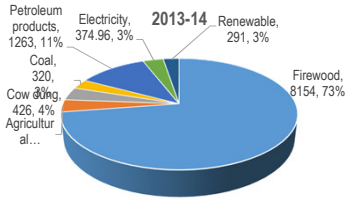
Source	Fiscal Year 2013/14 (000 toe)	Fiscal Year 2014/15 (000 toe)	Fiscal Year 2015/16* (000 toe)
Traditional	**8983**	**9104**	**6069**
Firewood	8154	8264	5509
Agricultural Residues	403	408	272
Cow Dung	426	432	288
Commercial	**1958.96**	**5256.90**	**4609.77**
Coal	320	465	192
Petroleum Products	1264	4294.62	4143.46
Electricity	374.96	397.28	274.31
Renewable	**291**	**291.64**	**291.86**
Total	**11232.96**	**14652.54**	**10970.63**

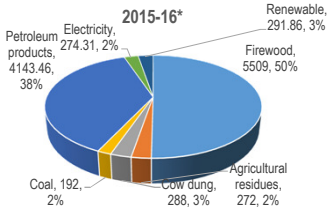
Source: Ministry of Energy ** Of first eight months*

Energy consumption status in Nepal, toe



1 toe = 42,000 MJ = 42 GJ





http://mof.gov.np/uploads/document/file/Economic%20Survey%202015-16%20-%20English_20160812062624.pdf

Nepal's national GHG inventory in 1994/95

GHG source and sink categories	Emissions 1994/95 (Gg CO_2 eq)	Emission share by sectors
Energy	3,266.90	8.4%
Industrial Process	165.00	0.4%
Agriculture	26,617.00	68.8%
Land use change and forestry	8,117.00	21.0%
Wastes	500.00	1.3%
Total	**38,665.90**	**100.0%**

Source: Initial National Communication Report, 2004

Prioritized sub-sectors for mitigation

Sector	Sub-sector	GHG emission, Gg
Energy	Residential	3,267
	Transport	
Agriculture	Livestock management	26,617
	Rice cultivation	
Forestry	Forest management	8,117
	Forest utilization	
Industry	Cement production	165
	Lime production	
Waste	Solid waste disposal on land	500
	Waste water handling	

List of technologies identified for TNA – Mitigation

Sector	Sub-sector	Technology
Energy	Residential	Improved mud cook stoves
		Metallic stoves for cooking and space heating
		Biogas for cooking
		Biomass pellets for cooking
		Bio-briquettes for cooking and space heating
		Electric stoves for cooking
		Solar water heater for space heating
	Transport	Biodiesel
		Electric vehicles
		Mass transport - Bus rapid transit system
		Mass transport – light rail transport
		Mass transport – electric train

List of technologies identified for TNA – Mitigation

Sector	Sub-sector	Technology
Agriculture	Livestock management	**Urea Molasses Multi Nutrient Blocks**
		Ammonia treatment of straw
		Straw silage
		Providing mineral blocks/MNB
		Chemical/mechanical feed treatment
		Diet quality and nutrient balance
		Selective breeding
		Modified rumen bacteria
	Rice cultivation	Fertilizer and manure management
		Alternate wetting and drying (AWD) technology
		Nitrification Inhibitors - Nimin application
		Tillage Technology
		Mid-season water drainage
		Agriculture biotechnology

List of technologies identified for TNA – Mitigation

Sector	Sub-sector	Technology
Forestry	Forest protection and management	Forest protection
		Improvement of harvesting techniques (silviculture)
		Improvements in the product conversion
	Sink enhancement	Analog forest
		Reforestation
		Afforestation (timber plantation)
		Agro forestry
		Urban forest
		Reducing emissions from deforestation and forest degradation (REDD)

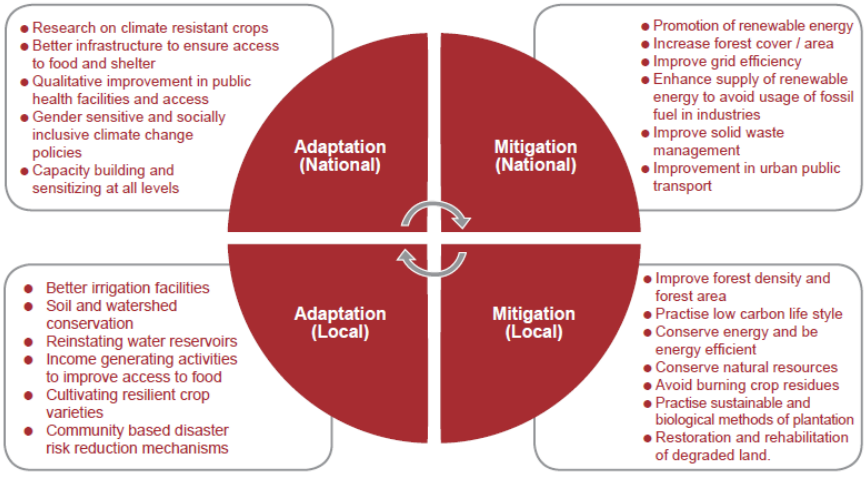
Silviculture is the practice of controlling the establishment, growth, composition, health, and quality of forests to meet diverse needs and values.

Mitigation approach in Nepal to minimize the climate change

Specific mitigation approaches include:

- Fuel switching from LPG to electricity cooking in urban areas and use of ICS and biogas in rural areas.
- Promotion of mass transport and railway in intra-city and intercity will provide better service and reduce consumption of fossil fuels.
- Promoting an alternate wetting and drying technology in rice cultivation and urea molasses multi nutrient blocks feed stock in livestock management will reduce the emission of methane; thus reducing the GHG emissions.
- Introducing silviculture and afforestation in forestry sector will increase the sinking capacity of CO2 by trees.

Climate change policy: A two pronged approach



Source: Nepal's climate change policies and plans: local communities' perspective. Environment and climate series 2011/1. HELVETAS Swiss Inter Cooperation Nepal

Conclusions

- It is noticed that the average temperature has been increased, the intensity of precipitation is observed, glacier retreats have occurred in Nepal.
- The impact will be in agriculture and food production, power generation, drinking water shortages, flooding, forest fires, etc.
- Various technologies have been identified to adapt and mitigate the vulnerability of climate change.
- Every citizen should be made aware of impact of climate change and encourage to use the technologies that are environment friendly and prevent us from disasters due to climate change.

Home works

- How much CO2 is absorbed by a tree in a year? If you plant the trees in one hectare land how much CO2 is saved to inject in atmosphere? Compare this value with the consumption of petrol by a car in year.
- Planting trees remains one of the cheapest, most effective means of drawing excess CO2 from the atmosphere. Discuss.