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Adaptation of Agriculture to Climate Change: Integrating and Mainstreaming Adaptation Measures in Agriculture Development Plans and Policies

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Abstract

This policy brief highlights approaches for identification of measures for immediate and long-term agricultural adaptation based on the risk knowledge of agriculture to climate change. The adaptation measures can be varied and location specific based on the specific risk for diverse climate change scenarios, related hazards, and their impacts. For sustainable adaptation, it should be integrated and mainstreamed in regular and periodic agriculture development program, which is delivered through existing institutional, technical and financial mechanisms. Existing strategies, policies and laws should be reviewed for effective adaptation whenever required. The paper argues that mitigation measures should also be part of adaptation.

Keywords: climate change, agriculture, adaptation

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Introduction

This policy brief highlights the strategies for identification of adaptation measure to reduce the risk of climate change on agriculture. Adaptation should pay attention to mitigation measures where it can accommodate and contribute to beyond reducing exposure and vulnerability of agriculture systems. Adaptation is a development process which needs to be integrated and delivered through periodic development plans and programs using and mobilizing existing institutional, financial,

technical and human resources. Adaptation should address both immediate and urgent needs, and anticipated long-term needs based on climate change risk scenario. The existing policies and strategies should be reviewed to make climate change mitigation and adaptation friendly and be enforced through legislations.

Identify and prioritize adaptation actions

Adaptation actions come from a broad spectrum of potential actions depending on the impacts and risks of agriculture from climate change. The ultimate aim of adaptation is to reduce the risk of climate change by building its resilience through reducing exposure and vulnerability. So, the activities need to be prioritized based on the magnitude of risk and impact they will address and the feasibility of the actions to deliver depending on the capacity of the country and the communities. Adaptation actions also include mitigation measures while enhancing resilience of agriculture sectors. So, adaptation measures should focus on reducing the magnitude of the three factors of risk and impacts, i.e., (i) climate change and related hazards, ii) exposure of agriculture system, and iii) vulnerability of agriculture system.

Mitigating climate change and related hazards as part of adaptation

Agriculture adaptation should address mitigation needs from this sector. Globally agriculture contributes 10–12% of Green House Gas (GHG) emissions (Edenhofer, et. al, 2014). For Nepal, it is the largest contributor of national GHG emission. It contributed 68.85% of national emission in 2008 without taking account of land use, land-use change and forestry (LULUCF) (GoN, 2014). The total emission of the country in 2008 was 30,011 Giga-gram Carbon-dioxide equivalent (Gg CO_2 eq) (Table 1) (GoN, 2016). Livestock methane (CH_4) and agricultural soil nitrous oxide (N_2O) are the key sources of GHG in agriculture sector. Therefore, it is very important that agriculture adaptation pay attention to mitigation measures so that the agriculture sector does not add more emission while promoting adaptation.

Table 1: Nepal GHG emission by different sectors, 2008

S.N.	Categories	CO_2 eq (Gg)	%
1	Energy	7,959	26.52
2	Industrial processes	632	2.11
3	Agriculture	20,662	68.85
4	Waste	758	2.52
	Total national emission	30,011	100.00

Source: GoN (2014).

It is vital to note two areas within agriculture from mitigation point of view; enteric CH_4 and CH_4 emission from manure management, and N_2O emission from soil management. Livestock feed management plays an important role in reducing enteric CH_4 emission. Capturing CH_4 released from manure and using it as a source of fuel will be the most appropriate approach for integrating mitigation and adaption. For reducing emission (mostly N_2O) from soil management, use of artificial chemical fertilizer should be discouraged and nature-based organic farming should be promoted. Burning of grassland and crop residues should be strictly restricted to reduce the GHG (CO_2, N_2O, etc.) emission.

Reducing exposure of agriculture to climate change

Two key factors under exposure are worth considering for agriculture adaptation to climate change for Nepal. These factors are: i) high proportion (almost two-third) of population engaged in agriculture, and ii) diversity of climate in Nepal with high trend and variability compared to global average. So minimizing exposure of agriculture to climate change means reduction in the number of farming population and farming activities and creating artificial climate through moderation of temperature, humidity, moisture, etc. in the farm.

Reduction of exposure of agriculture to climate change demands alternative non-agricultural livelihood options which are less sensitive to impact of climate change. It demands abandoning cultivation on lands which are exposed to climate change and related hazards beyond the capacity of adaptation. However, this is challenging because it needs a long-term plan, adequate resources and a lot of efforts. It also demands agriculture intensification to increase the production and productivity from reduced number of farming population. Aggregation of highly fragmented lands can support in agriculture intensification by introducing appropriate policy measures for land consolidation. Agriculture intensification also creates conducive environment for strengthening the market chain.

The other approach, the moderation of farm climate requires intensive financing, appropriate technology, and energy. The natural energy that exists in the air and that comes with solar radiation can be harnessed for climate modification at farm level.

Reducing vulnerability of agriculture to impacts of climate change and climate induced hazards

Followings are the key climate variables and climate induced hazards to which agriculture is highly sensitive. Agriculture adaptation to climate change requires responding to these climate variables and hazards.

a) Drought
b) Flood
c) Landslides
d) Emerging pests and diseases
e) Extreme weather events like hail, thunder, snowstorm
f) Long-term climate shock like change in average climate values
g) Agriculture volatility to market

Agriculture volatility (i.e., price, demand, supply) to market is non-climatic factor, but yet addressing the market issue strengthens the adaptation process.

Drought

Due to erratic rainfall and shifting of rainfall dates, drought-like situation is created, although the total annual rainfall over Nepal has not significantly changed. It is high time for building irrigation facilities with high priority where significant proportion of agricultural land lacks irrigation facility. Even under normal climatic condition, irrigation is a must for agriculture to ensure crops get water at their critical stages. Under climate change context, there is increased need of irrigation due to erratic rainfall pattern. The traditional rain-fed agriculture is facing frequent impact of drought. Different scales of irrigation infrastructure need to be built including the large-scale ones especially in terai, and medium to small in hills and mountains. Irrigation systems should also include appropriate micro-irrigation schemes at home garden and orchard levels. Irrigation helps maintain micro-environment temperature few degrees below the surrounding average.

Flood

In Nepal, frequency and intensity of flood are in the rise (Tiwari & Rayamajhi, 2018). Protecting agricultural land and crops from effects of flood is important for agriculture adaptation to climate change.

The agricultural land needs to be protected from erosion and bank cutting by flood for which nature-based biological methods such as planting trees or bamboo or other biological measures along the riverbank can be used. The biological measures also prevent floods with silts and gravels to enter crop land thereby preserving the quality of land and helping maintain land productivity.

In the low land terai plains, inundation is a problem. Crop species and varieties that can tolerate water logging for extended period of time need to be researched, tested, and promoted. Drainage should be properly managed to facilitate the smooth flow of run-off water to reduce the inundation both by depth of water and duration of inundation on crop land.

Monsoon has extended over a longer period, which has affected standing crops, especially paddy at their harvesting stage or just after the harvesting while lying on the field. The result is loss of quantity and quality of crop grains. More research are required to identify appropriate dates of planting and harvesting of crops to fit with the changing monsoon onset and withdrawal dates and also taking into account of other farm and local activities.

Landslides

Factors of landslides are basically i) the geological make up of lands ii) land-use category, and iii) run-off water from the rain. Earthquake has also increased landslide incidence in Nepal. Human efforts cannot modify the natural causes like geological fragility and the earthquake. The strategy should be to avoid cultivation on landslide prone areas. However, due to the limited cultivable land in hills and mountains, people are forced to cultivate landslides prone marginal lands. This needs mapping of landslide prone areas and risk assessment and abandoning high risk areas to the extent possible. Also to increase the production from limited land area, intensive production technologies should be promoted.

Management of runoff water is vital for reducing landslide. Since intensive rainfall events are increasing with change in climate, the current drainage management system for both settlement and farmlands are less efficient to reduce erosion and landslides. Structural measures such as increasing the capacity of drainage canals, strengthening their resistance against the force of runoff water and safely releasing runoff water to a larger natural drainage system are necessary. Appropriate biological and cultivation measures that could help increase water absorptive capacity of soil, reduce volume of runoff water and its current, and protect the land from scouring by run-off that lead to gulley and landslide formation should be promoted.

Pests and diseases management

There have been changes in type and time of occurrence of agricultural pests and diseases with which farmers are less familiar. Traditional practices for management of pests and diseases have limitations. They need to be modified per time and location of use. Farmers as well as service providers have to be trained to make them aware and competent to make informed decisions for the right practice in right time and location. Some of the appropriate practices could also include use of tolerant and resilient crop varieties and livestock species to pests and diseases.

Extreme weather events like hail, thunder, snowstorm

Incidences of extreme events are in the rise, but stakeholders seem not to be fully prepared to face those incidents. Such extreme events are becoming more erratic and abnormal than the past patterns. The strategies for reducing the risk are event specific. For example, to reduce the impacts from hail, physical structure like hail-net should be promoted. The damage from hail can also be minimized by intercropping trees in between annual crops. Impact of storms and thunders on crops can be minimized by managing wind breaks. These interventions also help maintain the farm temperature little bit below the surface average and meet multiple needs of the farmers at community and household levels.
For effective reduction of impacts of extreme climate events, artificial farm environment can be appropriate, for which farmers require financial resources, capacity and technologies. Daily weather forecast with advisories should be provided to the farmers to strengthen their capacity to respond to extreme weather events.

Long-term climate trends and shocks

Long-term changes in average value of temperature, rainfall, etc. are important climate shocks. Anticipated impacts of such shocks require thorough assessment through long-term research. Those research results could be of great help to develop technologies well in advance. Advanced climate science for reliable forecasting and scenario building and

sound agricultural technologies need to be developed and applied for long-term adaptation initiatives to best fit for anticipated future climate.

Agriculture volatility to market

Agriculture is a part of greater economic system of the country, the region and the globe. While implementing adaptation measures, it is essential to pay attention to wider economy and supply chains. Agriculture is the most sensitive sector to market stimuli because of its seasonality and perishability. If producers do not trust market system vis-a-vis if the market system is not supportive to producers, agriculture adaptation measures cannot be sustainable. The farmers should get inputs and services in time with quantity and quality they need. Regulation of reasonable market price is equally important. Post-harvest markets should be assured to encourage farmers to continue producing agricultural products. Since the purpose of agriculture should be beyond subsistence, sound market system is essential for agriculture adaptation to climate change.

Integrating adaptation actions in agriculture development plans

Action points for adaptation should be integrated in appropriate and relevant periodic and annual agriculture development plans at sub-sector level and at individual crop and livestock species level. The government has annual, short-term and medium-term planning cycles. The identified action points for adaptation should be integrated in the respective plans at appropriate stages at all government levels – federal, provincial and local. The local government may need assistance from federal and provincial governments for integrating climate change adaptation in agriculture across the planning steps. At provincial level, the adaptation action points should be integrated in long-term, short-term, and annual agricultural development plans.

At the national level, the National Planning Commission (NPC) guides the integration of action points in the plans. The Ministry of Agriculture and Livestock Development (MoALD) and relevant ministries integrate the adaptation needs in their periodic and annual plans. The NPC and MoALD are the leading federal government organizations for agriculture adaptation to climate change which coordinate with relevant federal and province government units to integrate the adaptation actions in their periodic and annual plans. These federal institutions have the responsibilities of strengthening capacity for agriculture adaptation to climate change of other units, including local level. The ultimate goal is to integrate relevant agriculture adaptation actions in short to long-term plans of all the governments.

Delivering adaptation actions

For effective delivery of the strategy, there is a need of i) institutional mechanism, ii) financial mechanism, iii) technical mechanism, and iv) capacity or skill mechanism of the stakeholders and the beneficiaries.

Institutional mechanism

The adaptation plans should be delivered through the existing legal institutions. For institutionalizing climate change adaptation program across the sectors, Nepal has "Environment Protection and Climate Change Council" under the chairmanship of Prime Minister and inter-ministerial coordination mechanism under the Minister of Forest and Environment. The council is responsible for overall guidance and approval of policies and strategies. Thematic or sectoral ministries including MoALD are responsible to integrate climate change in the respective sectors. There will be focal points in each sectorial ministry to oversee that climate change adaptation needs are assessed, and the identified needs are integrated and mainstreamed in development plans and programs of the sector and subsectors. The sectoral ministries are responsible for delivery of the adaptation plans. The institutional mechanism exists at provincial and local government levels as well. The provincial and local governments can also develop their geographic area specific legal

instruments under the overall federal law for climate change adaptation.

Financial resources

Financial resources through regular budget, international funding and project-based additional funding need to be mobilized for delivery of adaption plans. Participation of private, community and cooperative sectors is vital to materialize adaptation programs and actions. Similarly, other programs and projects funded by different sources such non-government organizations should integrate and support climate change adaptation measures by mobilizing their financial resources to make their interventions climate resilient.

Technological support

Climate change adaptation is largely a technical subject. Thorough and continuous research and study are required for developing actions to respond to climate changes effectively. As of now, most of the climate change adaptation programs and actions are seen as short-term actions, which cannot address the long-term adaptation needs. Thus, research and training are required for proper risk assessment of climate change and design and implement appropriate adaptation measures.

The technical team cannot be scattered through all local governments because of the expertise and the resource they need. Technical resources for planning could be pooled at federal level and delivery could be through provincial and local governments. Participation of federal and local level technical team in planning is vital to identify local climate problems and the potential needs.

Capacity building

There is a need for capacity development of stakeholders -- farmers to planners and decision makers -- to enhance their respective roles for adaptation. The institutions established for climate change adaptation within the ministry should develop plans for capacity development and deliver it for effective and efficient adaptation at federal, provincial and local levels. Similar to technological support, the support for capacity building can be located at different government levels depending on the need for capacity building at respective levels.

Monitoring, evaluation, and learning from adaptation actions for scaling up and scaling out

Adaptations are technology driven logical interventions to reduce the risk and impacts of climate change. A strong monitoring system should be in place to look at how climate scenario is reliable, how systematically climate change is affecting agriculture, how smart the identified adaptation actions are, how effectively they are delivered on the ground, and how these adaptation actions are meeting adaptation needs of the farmers, especially the most vulnerable ones.

It is vital to document the learning and design future adaptation actions building on those learning. Ultimate aim of monitoring, evaluation and learning is to enhance replication and scaling up of adaptation technologies and approaches by influencing policy and practices of stakeholders, especially the government.

Monitoring, evaluation and learning should be institutionalized within the MoALD. A separate unit for monitoring, evaluation and learning on climate change adaptation within the ministry may not be necessary, but the system should be built in the existing institution and its practices.

Documentation, learning and dissemination system and practice for adaptation initiatives should be established within the overall agriculture adaptation to climate change program by building capacity of the responsible staff and by using information and communication technologies.

Adaptation approach

Agriculture adaptation should be based on robust climate scenario using the latest science and participatory approach. Since adaptation

is to deal with uncertain and future climate events it should be backed up by research.

Climate scenario-based approach

Climate scenario is mandatory for adaptation now and in the future. Such climate scenario should look at change in average values of climate variables, the extreme events, the frequency, and their geographical, and temporal dimensions. The scenario is also required for climate induced hazards like flood, landslides, drought, etc. for different time periods and seasons.

Participatory approach

Climate change has localized characteristics and impacts. A single technology may not address adaptation needs for multiple locations even though similar or same climate exists. Every localized impact needs specific adaptation measure. Documented localized information are rare. Therefore, community participation is vital for information of local climate and its specific impacts. Participatory approach helps identify capacity and adaptation needs of the communities as well as the ultimate beneficiaries.

Continuous research driven adaptation

Adaptation is not a one-time intervention. It is a continuous process. As the climate and socio-economy change risk profile and adaptation needs change. Similarly, research for agriculture adaptation should be continued to meet the changing needs. It should be a part of agricultural research as a cross cutting theme across crops and livestock, and their subsectors.

There should be a clear understanding on how crop and livestock species respond to climate stimuli. Unless such potential responses are well understood, right interventions cannot be identified. Identified potential stimuli make the bases for resources mobilization, capacity building, formulation of policy, and institutional frameworks. Nepalese Universities, Nepal Agriculture Research Council (NARC), National Academy of Science and Technology (NAST) and other research and academia can be the part of research for agriculture adaptation to climate change.

Existing policies, strategies, and acts relevant to adaptation of agriculture to climate change

Many strategies, policies, and acts related to agriculture adaptation to climate change exist in Nepal. Many of them, however, do not pay attention to assessment of risk and impacts of climate change on agriculture. They assume climate as a static factor over the years and do not recognize the future climate change scenario, its impacts and the need to plan and implement interventions.

Furthermore, the existing policies have focused more on current climate. They do not clearly provide strategies on how to address the adaptation needs for the future climate. The stress is still on NAPA (National Adaptation Program of Actions) that focuses on urgent and immediate needs rather than NAP (National Adaptation Plan) that focuses on medium to long-term needs.

Some policies have provisions for carrying out Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) for developing programs and activities. However, there is no clarity on how climate change will be part of IEE and EIA. The provisions in policies need to be reflected in the legal documents so that they can be enforced in practice, which is not the case for several policies now.

In this context, there is a need to have a comprehensive agriculture adaptation strategy to climate change that elaborates a systematic adaptation need assessment approach with focus on the future needs. Such strategy document should be supplemented by a guideline making it legally mandatory to follow or apply for developing and delivering development plans for various time frames at federal, provincial and local government levels.

Disclaimer: *The views expressed in this article are of the author and do not necessarily reflect the official views of Research and Policy Brief Editorial Committee of NAPA.*

References

Edenhofer, O., Sokona, Y., Kadner, S., & Christoph J.M. (2014). Climate Change 2014: Mitigation. Final Draft Technical Summary IPCC WGIII AR5; Quoted in "Land use related mitigation benefits and co-benefits of policies, practices and actions for enhancing mitigation ambition and options for supporting their implementation, Technical paper by the secretariat. United Nations FCCC/TP/2017/9: 13 September 2017"

GoN. (2014). Second National Communication to UNFCCC. Ministry of Science, Technology and Environment. https://unfccc.int/resource/docs/natc/nplnc2.pdf

GoN. (2016). Nationally Determined Contributions, Ministry of Population and Environment. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20First/Nepal%20First%20NDC.pdf

Tiwari, K. R., & Rayamajhi, S. (2018). Devastating Monsoon: Water Induced Disaster Management Practices in Nepal. Forestry: Journal of Institute of Forestry, Nepal. 15, 15-76.