

A REPORT ON

# EXPLORING CLIMATE ADAPTIVE MECHANISMS ON WATERSHED MANAGEMENT



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**Submitted to:**

Climate Adaptation Designing  
and Piloting Nepal (CADP-N)  
Sanepa, Lalitpur, Nepal

January 2011

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### **Citation:**

Thapa K., G.B. Sharma, R.B. Rana, K. Lamsal, and S. Subedi. 2011. Exploring climate adaptive mechanisms on watershed management. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Kaski, Nepal.

### **Acknowledgement**

We are thankful to all LI-BIRD staff for their valuable input in this pilot and input during the report's final preparation. We appreciate Dr. Shreeram Prasad Neopane, Executive Director, LI-BIRD and Mr. Abishkar Subedi, Programme Director, LI-BIRD for their constructive input to refine the pilot and report. Our sincere gratitude goes to Dr. Deepak Rijal, Climate Adaptation Design and Piloting Nepal for his regular backstopping, and Ms. Sibongile Pradhan, Climate Adaptation Design and Piloting Nepal for her technical input during design and technical editing of this report. UK Department for International Development is acknowledged for the financial support for this piloting. Last but not least, we are thankful to the local community of the rupa watershed for their local efforts to successfully complete this pilot and achieve the results.

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## EXECUTIVE SUMMARY

Exploring Climate Adaptive Mechanisms on Watershed Management is one of the pilot projects, implemented by Local Initiatives for Biodiversity, Research, and Development (LI-BIRD), under Climate Adaptation Design and Piloting Nepal (CADP-N) mechanism supported by UK Department for International Development (DFID) and Ministry of Environment (MOE), Government of Nepal. The main objective was to explore mechanisms for the management of Lake Watershed through mainstreaming and mobilizing local institutions in Rupa Lake Watershed in Kaski district of Nepal.

The pilot followed participatory approaches and tools for community consultations, orientations, community awareness, and scoping climate change and management issues at watershed scale. The key indicators of climate change as perceived by local community are increased sedimentation, decreased agriculture performance, decreased agriculture workforce due to intermittent rainfall and dry spells. Farmers have observed shift in rainfall period from June-August to July-September. Incidence of crop pests has increased with increased foggy weather and frequent dry spell.

The interaction revealed that the communities have adopted several adaptation strategies and measures in responses to climate change impacts.

Reforestation in the degraded and eroded lands with fodder trees and forages, construction of gabions and loose stone check dams or split bamboo barrier, and bioengineering practice are some of the effective measures for gully control, reducing soil erosion and sedimentation downstream. Strengthening market linkages is vital for community adaptation to adjust stresses posed by climate change. Assigning clear roles for different local institutions in managing ecosystem resources could be a milestone for developing community ownership.

Broadening livelihood options through improved market access to value added products, promoting eco-tourism, access to information enhances adaptive capacity. The strategies that diversify livelihood, provide option to the community, add value to their products, and link their products with the market have increased adaptive capacity thereby making community more resilient to the climate change impacts. Promotion and adoption of organic farming, agroforestry systems, integration of legumes in the farming system (especially in rain-fed or upland farming system), promotion of crop varieties developed through decentralized breeding are key agriculture initiatives to address drought and flood.

Cultivation of non timber forest products and strengthening network for their market is another strategy to diversify livelihood. Increased utilization and conservation of crop varieties through seed banks and field gene banks, identification and promotion of climate stress tolerant (particularly drought, flood, and pest) underutilized crops in the farming system, integration of fruits in the farming system, and integration of small farm animal species of local origin and introduced in farming system are adaptive strategies. In addition, identifying and promoting income generating activities and adding climate proofing in them based on the niches is an important strategy that LAPA be built it.

A reciprocal benefit sharing mechanism between upstream and downstream communities was found effective to sustain management of ecosystem services from the climate change impacts. It has increased access of poor and marginalized communities to local institutions, market and has brought about a remarkable social change.

The mechanism of LAPA development and delivery should engage all local stakeholders and it must include district and village level governmental agencies, community based organizations, private sector and civil society organizations towards building a public private partnership as service delivery mechanism. The mechanism should assigned the defined roles for individual partners, the service providers. There should be a two way delivery mechanism of service in order to really enhance the adaptive capacity of the poor and climate vulnerable communities and the ecosystems.

A bottom up as well as top down monitoring and evaluation mechanism should be in place and should be implemented as equilibrium that ensures an effective and efficient implementation of adaptation interventions in Nepal. A two-way mechanism of monitoring and evaluating the LAPAs should be in place, in which a watershed or sub-watershed is recommended as a unit of LAPA.

In order to design and implement the LAPA, a thorough review of existing national policy and plans need to be carried out to build climate foresights. Adaptation planning should be made participatory. Political leaders, constitution assembly members and policy makers need to be regularly updated and upgraded climate knowledge along with the need of LAPAs and NAPA. Capacity building of stakeholders (local to regional and national level) on climate change issues is important to effectively and efficiently make LAPAs and implement these.

The learning and experiences generated from LAPAs provide important feedbacks to the local and national development plans, programmes and policies. Involvement of private sector, nongovernmental organizations and certainly the government institutions (development and academic institutions) is unique to LAPA if we are successful to demonstrate public private partnership on climate change. Along with the local bodies the local institutions including cooperatives and natural resource groups are potential entry points for designing and implementing LAPA.

# **1. INTRODUCTION**

## **1.1 GENERAL CONTEXT**

Climate change seriously affects every livelihood dimension of people in least developed countries such as Nepal. Among them, poor and marginalized people with few livelihood options are often the most vulnerable to climate hazards such as floods and droughts (IPCC, 2007). In this context, the developed nations have agreed, through international negotiations under the umbrella mechanism of the United Nations Framework Convention on Climate Change (UNFCCC), to support adaptation in the most vulnerable countries. Support is being provided under UNFCCC mechanism through least developed country (LDC) fund, special climate change fund (SCCF), and adaptation fund. In order to access the LDC fund, these countries must have developed a National Adaptation Program of Action (NAPA) that identifies priority adaptation measures to meet urgent and immediate needs.

Nepal has recently prepared its NAPA through a country driven, inclusive and programmatic approach. The document has identified districts in Nepal with overall vulnerability to climate change and vulnerability to specific hazards such as drought, flood, landslide, and glacial lake outburst flood. The document has also prioritized nine combined project profile, based on adaptation strategies identified by six different thematic working groups (TWG) that cost about 350 million USD (MOE, 2010). Because of the varied microclimatic condition of Nepal and its rugged topography, NAPA has suggested preparing Local Adaptation Plans for Action (LAPA) to implement the most immediate and urgent adaptation needs prioritized by NAPA.

## **1.2 PROJECT CONTEXT**

This exploration of climate adaptive mechanisms for watershed management is one of the pilot projects under the Climate Adaptation Design and Piloting (CADP) mechanism supported by UK Department for International Development (DFID) and Nepal Ministry of Environment (MoE). It has been designed to contribute to the generation of experiences of potential adaptation strategies at local level. It explores service and finance delivery mechanisms, mechanisms for involving poor and climate vulnerable communities through LAPA process, and integration of LAPA into development planning.

An ecosystem based approach to natural resource management has been prioritized as a means to adapt to the effects of climate change at landscape level (MOE, 2010). In order to enhance adaptive capacity at watershed level, involving local communities with strengthened upstream-downstream linkages through various incentive mechanisms is seen as an effective strategy for sustainable management of natural resources and ensuring livelihood security (Regmi et al, 2009; Pradhan et al, 2010). Exploring climate adaptive mechanisms in Rupa Lake watershed of Kaski district can provide insight for a model of community based adaptation alongside watershed management. It will ensure longer term ecosystem services (water regulation, food, fibre, fishes, crop landraces, erosion control, local employment opportunities, etc) of the fresh water resources, including habitats of aquatic flora and fauna, forests, Non-Timber Forest Products (NTFP), birds, and wildlife through climate adaptation interventions.

This pilot project aimed to develop a participatory mechanism to manage a lake watershed through strengthened community initiatives for climate change adaptation to benefit the most poor and climate vulnerable with the following purpose and objectives:

**Purpose:**

Explore mechanisms for Lake Watershed management in order to facilitate climate change adaptation practices and strengthen management of the lake watershed through the involvement of local government and community based institutions

**Objectives:**

1. To assess the effectiveness of the existing and potential climate change adaptation measures (technologies and practices both local as well as intervened) in Rupa Lake Watershed and
2. To identify and pilot watershed level mechanisms (coordination, benefit sharing, and joint planning) to facilitate the adaptation initiatives.

### **1.3 INSTITUTIONAL CONTEXT**

LI-BIRD is a not-for-profit making non-governmental organization established in 1995 in Pokhara, Nepal. It is committed to capitalize on local initiatives for sustainable management of renewable natural resources and to improve the livelihoods of resource poor and marginalized people. LI-BIRD has contributed to the development of several innovative methodologies and approaches for participatory research and development, and has generated impacts that have enhanced the livelihoods of resource-poor farmers through appropriate technological and policy changes. LI-BIRD is recognized nationally and internationally as a centre of excellence for its contribution to shaping national policy, and for developing and promoting good practices for on-farm conservation of agricultural biodiversity. Because of its impact-oriented approach and professional accountability, LI-BIRD has become a partner of choice for farming communities and organizations engaged in research and development in agriculture and natural resource management.

## 2. METHODOLOGY

### 2.1 PILOT AREA – GEOGRAPHIC AND SOCIOECONOMIC OVERVIEW

The project was piloted in Rupa Lake watershed of Kaski District, western development region of Nepal. Rupa Lake is the third largest lake in the Pokhara valley. It is situated at an elevation of 600m asl (Kafle et al., 2008) and has an area of one square kilometre. The watershed shares its boundary with one municipality (Lekhnath Municipality: ward no. 9, 10, 11, 14) and three Village Development Committees (VDCs) namely Rupakot (ward no. 1, 3, 6, 8), Hansapur (ward no. 6), and Majhthana (ward no. 4 and 5). The pilot area in general has experienced increased temperature and more erratic and intense rainfall over the past ten years as perceived by local communities. As reported in the Nepal's NAPA, the pre monsoon rainfall in some pockets of Western Nepal is decreasing, whereas the trend of monsoon rainfall is increasing. In addition, there is a trend of increasing post monsoon rainfall on southern aspects of hills in western Nepal (MoE, 2010). The Nepal's NAPA document also shows a moderate overall vulnerability of Kaski district to climate change. However, the district has high vulnerability to landslides due to increasingly erratic and intense rainfall (MoE, 2010). Rupa Lake and the watershed is a popular tourist area. It is developing as an important agro-ecotourism destination in Nepal. Agriculture is the main occupation of the people living in the watershed.

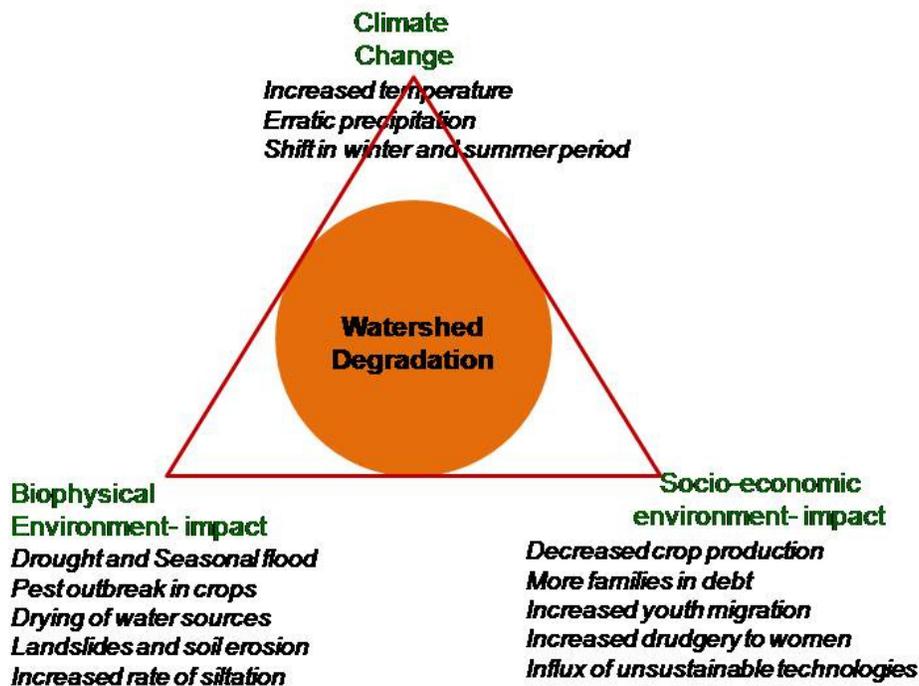


Figure 1. Impact of climate change in the livelihood and natural resources of the Rupa Watershed

The area is accessible to markets through a motor-able gravel road. The major market centres are Gagangauda, Shishuwa, Begnas Lake, and Pokhara. There are a range of local institutions operating in the watershed including academic and community based institutions. There are 4 secondary level governmental schools, 15 primary schools, 17 community forest user groups, 12 youth clubs, 5 farmers groups, 18 women's' groups, 6 cooperatives, and 2

community based organizations (one focusing on farm production and other for biodiversity conservation).

Impacts of climate change in the watershed are clearly observed in the lake ecosystem and the livelihoods of nearby communities (figure 1). A major indicator of climate change in the lake is increased siltation, whereas an indicator for livelihoods is the decreased agriculture workforce, declined productivity due to prolonged drought and erratic rainfall. Weather pattern changes include erratic rainfall of high intensity and short duration, less cold days (shortened winter), increased foggy days and a lack of rain for the rest of the year. The major climatic hazards in the area are heavy precipitation, increased temperatures and prolonged dry spells.

During the community consultations at downstream and upstream, farmers shared their experiences about the current pattern of climate change of the area. They have experienced a shift in timing of monsoon rain (delayed onset) from June-August to July-September. Increased incidences of crop pests due to increased foggy days and prolonged dry spells have reduced agriculture performance. Fog during winter had an impact on the rice harvesting, threshing and drying. In the summer, higher temperatures have even resulted in the dying of fish. Due to intense and erratic rainfall that results flash floods in natural springs including feeder streams of Rupa Lake, coincided with agriculture practices increased accumulation of soil and sand in the lake. During such flooding the extent of dying fishes in the lake is growing.

## **2.2 APPROACH AND TOOLS**

The pilot used participatory approaches and tools for community consultations, orientation and capacity building during field piloting. Initially, the project identified its boundary actors (Table 1) which included individual farmers, their institutions, and local bodies (village development committees and the municipality). These boundary actors were the people and organizations with whom the project worked and expected to be able to influence behavioural changes that would result in increased adaptive capacity of households and ecosystems. During the piloting several community level workshops and meetings were organized to identify community perceptions on climate change and local response measures. One broad consultative workshop was organized at watershed level. During this workshop, all institutions active in the watershed were made aware of the issues and mechanisms of climate change and, current climate change adaptation practices in the watershed and practices that might help them [i.e. less top down approach!] respond to climate change. In addition, separate meetings and workshops were organized separately with upstream and downstream communities and local institutions. There were also focus group discussions and key informant interviews along with transect walks conducted to identify existing and potential adaptation measures, mechanisms for implementing adaptation plans through improved finance delivery mechanism.

In another attempt, the climate and livelihood contexts of the watershed were assessed using CRiSTAL (community risk screening tool-adaptation and livelihoods). Tools such as the historical time line, hazard mapping, seasonal calendar, participatory transect walk, and

vulnerability and adaptation matrix were used to assess vulnerability<sup>1</sup>. Community responses were assessed to understand the ways community respond to climate hazards. During focus group discussions, a cost benefit analysis was done, along with multiple criteria and gender sensitivity analysis to identify and prioritise the most immediate and urgent needs of the communities. This process began with participatory discussion of existing and potential climate change adaptation options with the community. Then the economic, social, and environmental costs and benefits of the adaptation options were scored by communities from zero to five (0 being no cost or no benefit, 1-2: low cost or low benefit, 3: medium cost or medium benefit, 4-5: high cost or high benefit). The prioritised adaptation options were then supported for piloting through local community institutions. During the community consultations, institutional mechanisms were identified to facilitate adaptation in the watershed. Some options that ensure active participation of vulnerable communities were then piloted in collaboration with the Rupa Lake Rehabilitation and Fishery Cooperative. Additionally, dialogues were initiated with the municipality, key community members and VDC secretaries to integrate local adaptation responses through the joint planning process.

Table 1: Boundary actors of the pilot and its desired behavioural change in them

S.N.	Boundary Actors	Behavioural Change (behaviour, relationships, actions, information)
1	Community members (operating as household level)	Farmers/community members practice watershed management actions to respond to the impacts of climate change  Adopt climate change adaptation measures in agriculture and other natural resources to secure their livelihood
2	Community institutions (Cooperatives, farmers groups, mother groups, community forest user groups and youth clubs)	Community institutions organized to deal with climate variability by inclusively practicing adaptation options and mechanisms
3	Local government institutions: -Village Development Committees (Rupakot, Hansapur, Majhthana) -LekhNath Municipality	Climate change adaptation mainstreamed in VDC planning Climate change adaptation mainstreamed in municipal planning

Table 2. Cost benefit analysis of the community prioritized adaptation options for watershed management.

Cost Benefit→  Activities↓	Cost (0-5)			Benefit (0-5)		
	Environmental	Economic	Social	Environmental	Economic	Social
Promotion of minimum tillage operation						
Plantation in the degraded and eroded land						
Construction of check-dams						
Protection of water sources						

<sup>1</sup> LI-BIRD had organized a climate integration workshop on June 20-15 in Begnas. During that workshop, participants were oriented on those tools to carry out climate risk assessments in the watershed by dividing them in 4 groups. During this pilot, information generated was used to identify the climate and livelihood contexts as well as vulnerability.

### **3. OUTPUTS / FINDINGS**

#### **3.1 INSTITUTIONAL AND FINANCIAL MECHANISMS**

The pilot found some institutional and financial mechanisms in the watershed that facilitate adoption of climate adaptation practices and strengthen integrated management of watershed resources. The institutions in the watershed have inclusive financial mechanisms to increase an access of poor and marginal communities to these. The following institutional mechanisms were found inclusive to poor and marginalized communities including the disadvantaged groups and mobilize watershed communities to implement climate adaptation interventions in the watershed.

*A reciprocal benefit sharing mechanism between upstream and downstream communities was found to sustain management of ecosystem services from the impacts of climate change. In order to sustain the management of lake by engaging all stakeholders of the watershed, a payment mechanism is in place in the watershed which has a value to integrating in the LAPAs.*

A mechanism of payment of ecosystem services is established between upstream and downstream communities in the watershed. As expressed by the communities in the watershed, this mechanism is meant for a sustainable management of ecosystem services of the watershed. This mechanism has been facilitating climate change adaptation practices such as reforestation, check-dam construction and bioengineering to reduce soil erosion during rainy season. Until recently the mechanism of payment is voluntary and is in cash and kind, in which the Rupa Lake Rehabilitation and Fishery Cooperative in the downstream pays 20% of its total annual income to the upstream community institutions (CFUGs) and academic institutions (primary schools) to implement climate proofed practices. The payment to schools is used for providing scholarship to the students and organizing awareness raising programmes about biodiversity conservation. CFUGs are utilizing the payment in the management of community forests such as constructing check-dams and plantation in the degraded forest areas.

*Cooperatives increase market access to poor and marginalized community that likely to bring social changes.*

The downstream cooperative provides jobs to the Jalhari community, who previously were dependent on the lake for their livelihood. Their children have been receiving scholarship from the cooperative. Such provisions have brought a social change in their lives by increased income, educating them for conservation, and supporting their children's' education. Promotion of goat rearing by a cooperative in the upstream in collaboration with LI-BIRD has provided a source of income for the poor members of the community. In 2007, LI-BIRD through a project funded by the Development Fund Norway supported NRs. 15000.00 for 15 dalit households upstream in Lekhnath Municipality-10. The project also supported them by paying for the share (each share costs NRs 500.00) so that they become the member of the Pratigya Cooperative. The individual members started rearing goat and poultry from money the project provided (NRs 1000.00 for each household) and the money borrowed from the Cooperative. At present, they have earned money from goat farming, bonus from the cooperative and they have paid the loan back to the cooperative. Mr. Bhim

Bahadur Pariyar aged 65, who was involved in this scheme, changed his livelihoods totally from a plough man to goat farming. But now, he has 7 goats and has already sold 6 he-goats. Now days, his livelihood is sustained by the income from goat rearing and has given up ploughing others land.

*i. A synergistic association of community organizations and development of social cohesion is important for LAPA.*

A number of community based and community led institutions are operating in the watershed. These include community forest user groups (CFUGs), cooperatives (with low share and high share values), mother groups, women groups, farmers groups, and youth clubs. The CFUGs are working actively to manage forests while Cooperatives are in managing micro-finance for improved utilization, product development and marketing of natural resource base products. Several youth clubs are active in managing watershed to ensure ecosystem services. Awareness activities by the youth clubs have decreased threat to biodiversity (particularly for birds) from the children. Mother groups and women groups are responsible for maintaining sanitation in the community as well conservation of specific local crop species. They are also involved in the management of biodiversity by conserving special conservation blocks. Such institutional mechanism at the local level has increased social cohesion in the community and thereby enhancing social asset to deal with climate change.

*ii. Mobilizing community through group funds help strengthen ownership*

*Batabaran Sanrakshyan ra Samudaye Bikas Samiti* (Environment Conservation and Community Development Committee) is a committee based in Lekhnath Municipality 11, Sundaridada (upstream). It was formed in 2007 to initiate conservation of biodiversity as well support community development through income generating activities. In order to initiate conservation activities, LI-BIRD established a group fund of NRs.30,000.00 to mobilize community for biodiversity conservation and support local initiatives that strengthen livelihoods. The committee has been mobilizing this money among the group members (amounting maximum up to NRs. 2000.00) with 12% interest rate. While providing loan they had a clause that the member taking loan must pay half of the principal (to provide loan to other members also) with interest within sixth month time and the remaining half by the end of the year. The members of this committee use this loan money for bee keeping (by 20 households) and local goat (*Khari* breed) by 8 households. Initially, they had planned to invest the loan for commercial vegetable production but were unable due to lack of irrigation and problem of monkey. On the other hand, the committee has been contributing conservation of orchid of the area in a conservation nursery where they have conserved 33 varieties of orchid. In addition, it has increased awareness in the community for biodiversity conservation.

*iii. Establishing a market linkage of the products from the community is crucial to adapt to the impacts of climate change through value addition, tourism, and information access.*

Some climate resilient development interventions are initiated by the downstream communities to promote ecotourism. They have constructed green road with green plantation in the edges such as broom grass, narkat, bottle brush etc. The green plantation in the edges is to reduce erosion of soil during erratic rainfall. Construction of green road in

the downstream has enhanced access of watershed community to the market and information. In addition, it has promoted tourism in the area.

#### **Case 1**

Pratigya Cooperative in the Rupa Lake Watershed was established in 1997 with 43 share members. Conservation of threatened species, value addition of local crops and marketing of them for their sustainable management is the priority of the cooperative. The major climate change impacts in the community are decreased agricultural production due to frequent and prolonged drought as well as erratic rainfall pattern. In such context, mobilization of community members through cooperative by conserving local drought tolerant underutilized crops, maintaining a diversity of crops in their field, supporting the poor and marginal farmers to sustain their livelihoods are the key strategies that have enhanced their capacity to deal with drought and heavy precipitation. Value addition of local crops has enhanced their access to market and information. The cooperative members at current have promoted marketing of anadi, local landrace of sticky rice, after the members realized the market potential for its medicinal, cultural, and traditional value; and marketing of taro products through value addition. They have been selling products from all parts of the plant (root, pseudo stem and leaves) of taro and sticky rice through cooperatives. Initially (in 1999), they hardly collected around 0.15 quintal of anadi rice but this amount reach 200 quintal in 2009/10. Similarly, they sold taro products of NRs. 15000 in 1999, whereas they earned NRs 35000 by selling the products. In addition, the members of the cooperative are maintaining field gene banks of different taro species and conserving the medicinal and aromatic plants. The cooperative has in total 78 members; among them 38 are female, 6 are from a local food wholesaler (Shital Agro-products), and 15 are dalit community. Poor and marginalized community members have also got membership to the cooperative and have been selling their rice and taro products through it. Every month, on 19<sup>th</sup>, each member of the cooperative contributes Rs. 50 in their revolving fund. Now days, goats are an important sources of income to these households apart from taro and anadi. With the increased income, they are able to send their children to the school and are happily celebrating the festivals.

- iv. *Assigning separate roles to separate groups for management of ecosystem resources is fruitful and effective to develop ownership (coordinated efforts at local level).*

In order to manage the lake resources, commercial fish farming is practiced in the downstream communities. They have also managed the lake biodiversity by establishing and maintaining different conservation blocks which are being assigned to be managed by mother groups, cooperatives, and women groups. In the different conservation blocks, they have conserved wild rice, local fishes, wetland based floras (such as white lotus and kade simal), and birds. As for example Jamunkuna Mother Group (which is beside the lake) is responsible for conserving wild rice. Similarly, bird conservation role is assigned to another mother group in another corner of the lake.

- v. *Cooperatives play a key role in making financial provisions inclusive to benefit poor and marginalized community members.*

The current mechanisms operating in a cooperative in the upstream named Pratigya Cooperative is also a climate adaptive institutional mechanism in the watershed. The cooperative has included the dalit and poor communities in their shareholding which is a low share value (NRs 500/-). In addition, they have supported these communities for goat farming and have also involved them in marketing of other local products prepared from Anadi rice, taro, and medicinal and aromatic plants. Local group and microcredit schemes of various mother groups, farmer groups, CFUGs and youth clubs are very important to integrate adaptation plans into development planning. These groups can be effectively mobilized both in planning and implementation of the LAPA. The downstream cooperative has also strategically supported poor and marginalized community members by offering employment. This Cooperative has also provided share to poor and marginalized community members by deducting from their salaries in different stalls.

- vi. *Provision of group share is effective to provide share to the poor and marginalized community members in the cooperative's scheme with high group share but has great market linkage and opportunity.*

Because of the large value of the share (NRs. 15000/-), poor and marginalized community members are indirectly excluded simply because they are too poor to buy high value share. In this pilot a mechanism is introduced whereby group share will also include poor and marginal household members. It was endorsed through a series of meetings with cooperative members in the Rupa Lake Rehabilitation and Fishery Cooperative. Through the meetings, cooperative members agreed to amend cooperative bylaws where provision for group share can be sold. This pilot supported to purchase shares for two groups (one with 15 members and other with 25 members). Similar practice can be expanded through cooperatives that gradually include the marginal and fisher men dependent on traditional fishing.

### **3.2 CLIMATE CHANGE ADAPTATION MEASURES IN THE WATERSHED**

From discussions with community members, a number of techniques and management practices are documented that respond to the impacts of climate change. Local communities in the watershed have been adopting autonomous responses to manage natural resources and agroecosystem resources from the impacts of climate change. In addition, there are institutional mechanisms and structures operating in the watershed that increase the adaptive capacity of communities to deal with climate change and the associated climate hazards. [many of these were mentioned in the section above]

Communities that live in similar landscapes or a watershed have many things in common both in terms of experiences of climate change and responses. Based upon the pilot assessments and observations of several practices, we recommend the following interventions to be integrated while preparing local adaptation plans for action.

#### **3.2.1 Measures for adaptation in natural resources to erratic rainfall and dry spells**

- i. *Reforestation in the degraded and eroded lands and plantation of fodder trees and forages in the public and eroded land (for long term investment),*
- ii. *Construction of gabions and loose stone check dams or split bamboo barrier (for short term investment).*
- iii. *Bioengineering practice for gully control and control of soil erosion*
- iv. *Promotion of minimum tillage operation*
- v. *Protection of water sources*

The major climate risk to the natural resources, as portrayed by the local community, is erosion of soil and its deposition in the lake. The rate of siltation in the lake is expected to be increased due to heavy and erratic precipitation/rainfall as a result of climate change. Watershed community has experienced high erosion of soil in the degraded forest and pasturelands. In order to reduce the loss of soil and the resultant siltation in the lake, communities in the upstream are adopting reforestation in the degraded forest areas and eroded lands and are actively managing the forests by forming community forest user groups. People have started planting fodders and forages such as *napier, rai khanyu,*

*amriso, narkat, badahar, etc* in the public and eroded areas. They have also initiated protection of water sources by planting and conserving the sources. Along with the plantation, they have constructed gabions, loose stone check dams, and split bamboo barrier to reduce stream bank cutting and check erosion by controlling run off. In the gully and eroded areas, they have initiated bioengineering practices to control soil erosion. One of the main species to minimize loss due to flash flood is bamboo plantation along the bank of the spring.

These practices are seen effective to reduce deposition of eroded soil into the lake. As an immediate response, bioengineering, construction of gabions, loose stone check dams and split bamboo barrier are effective to control soil erosion from the surface run off. In the longer term, the plantation is seen beneficial to reduce erosion and stabilize the rain drop impacts.

### **3.2.2 Measures for adaptation in agriculture**

Through discussions with communities, key informant interview, and transect walk it was found that households and communities are initiating a number of practices to respond to flood and drought due to climate change. Some of which are autonomous and other promoted by LIBIRD and other means such as by District Agricultural Development Office (DADO), District Soil Conservation Office (DSCO), and CARE Nepal. During designing the LAPA and initiating adaptation on the ground the strategies below are helpful as experienced in the pilot watershed. They were reported in the discussions by cooperative members, representatives from community forest user groups, farmers' groups, mother groups, and local community based organizations.

#### *i. Organic farming*

Some farmers were found to use well decomposed organic manure in the production system. They were also using organic pesticide made from cattle urine and other locally available plant materials (such as stinging nettle, artemisia, justicia, etc) to manage pests in their crops. From such practices, they reported number of benefits to the environment, especially for bee keeping and mitigating some drought as they had experienced a need of less irrigation.

#### *ii. Agroforestry farming system*

Integration of fodder trees such as *rai khanyu, badahar, amriso, pakhuri, kauro, kutmiro, phaledo, narkat, napier, etc.* in the farming system has promoted organic farming by supporting livestock rearing. In addition, agroforestry system has adapted well to the drought as experienced by farmers.

#### *iii. Legumes in upland farming system*

Farmers have found legumes such as cow pea, pigeon pea, rice bean, horse gram, black gram and soybeans to be drought-resistant and that their integration contributes to maintaining the yield from the production system. Farmers have experienced these crops to be most useful in the rain-fed farming system.

#### *iv. Crops developed by participatory plant breeding and participatory variety selection*

Farmers are cultivating rice varieties such as Mansara 4 and Biramphul to adapt to drought, flood, and lodging in some parts of the watershed. In addition they are getting 20-30% more

yield than from the local landraces of these varieties even in the context of climatic variability.

*v. Cultivation and marketing of non timber forest products to diversity livelihoods and utilize marginal land*

Cultivation of non timber forest products including medicinal and aromatic plants has been initiated by a few member of the watershed community. The practice of cultivating medicinal plants has better utilized marginal farm land as well as linked local products to the nearby market thereby diversifying the sources of income. In the pilot area, a local healer, Mr. Jaya Bahadur Thapa<sup>2</sup>, has been linking those medicinal products with the market in Pokhara by making different treatment combinations for different diseases such fever, common cold, jaundice, gastric, etc.

*vi. Conservation of local crop varieties through seed banks and field gene banks*

Maintenance of local crop landraces is important to develop crops that perform well in a changed climatic context. Conservation of those local landraces through seed banks and field gene banks was found in the pilot area. It was seen by households as a means of being prepared for and adapting to droughts, floods, and attack of crop pests.

*vii. Identification and promotion of climate stress tolerant underutilized crops in the farming system*

Farmers were found to have options of crops that are tolerant to climate stress such as drought, floods and pests. They have maintained cultivation of some drought tolerant neglected and underutilized crops in their home gardens. These crops and their species contribute to sustain their livelihood in times of stress due to climate variability. In the pilot site, crops such as taro, yam, brinjal, local tomato, and legumes were found.

*viii. Integration of fruit in the farming system*

Farmers have integrated fruit like banana, litchi, jackfruit, pineapple, citrus, guava, pear, peach, and plum in their farming systems, especially in the home gardens. Integration of coffee has contributed to providing additional income, reducing soil erosion, and utilizing the farmland efficiently. The fruit trees are mostly perennial and resist drought and help stabilize the soil. In addition, there are a source of family nutrition and income to the farmers.

*ix. Integration of small farm animals and their local breeds in farming systems*

Livestock is an integral component of farming systems in the watershed. The rearing of small farm animals such as chickens, ducks and goats has supported the livelihoods of poor and marginalized households. It has supported farmers by promoting organic farming as they were using goat manure in their farms, promoting agroforestry to supply forage and fodder to the goats, and by diversifying income sources within agriculture (goat keeping along with vegetable farming and rice farming in small plots). Compared to the large farm animals such as cow and buffalo, raising of small stocks such as local chicken, duck, and goat and their integration in the farming system reduces risks from climate hazards (Neopane et al, 2010).

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<sup>2</sup> During transect walk and field interactions, we had an interaction with him and observed his medicinal and aromatic plant farms and their products.

*x. Identifying and promoting income generating activities that are climate proof*

As a means of generating income, farmers are doing bee keeping and mushroom cultivation in the watershed. Though these businesses are climate sensitive, bee keeping and mushroom farming is important sources of income for the farmers. In some areas of watershed, farmers have started bee keeping at commercial scale which has contributed to promote organic farming in the area. In addition, such farming practices have enhanced social cohesion thereby increasing integrity in the management of watershed services.

Among those above mentioned interventions for agriculture and natural resources, the following interventions are found to be effective, from cost benefit assessment along with multiple criteria, to minimize the impacts of climate change in the watershed.

- i. Promotion of minimum tillage operation
- ii. Plantation in the degraded and eroded land
- iii. Construction of check-dams
- iv. Protection of water sources

With this analysis, the piloted supported 8 community institutions of the watershed to initiate construction of check-dams, protection of water sources, and do plantation in the degraded and eroded area.

### 3.3 MECHANISM OF SERVICE DELIVERY IN THE WATERSHED

From the discussion with watershed community that included representatives from mother groups, cooperatives, community forest user groups, and poor and marginalized members and meeting with VDC and Lekhnath Municipality, the pilot identified a public private partnership (PPP) mechanism of service delivery by defining the clear roles and responsibilities of each actor. It becomes effective only when all actors are involved both in planning and implementation of the plans (Table 3). During the discussion, community members defined different roles for different stakeholders including district line agencies, NGOs and private sector. However, they represented themselves as the primary implementer of adaptation options, whereas the role of other partners were identified for joint planning, technical support and market linkage of the products of the watershed. During the discussion, poor and marginalized community members had asked for direct services of adaptation works to support their livelihood with less delay in fund channelization.

Table 3. A mechanism of service delivery of the adaptation options in the watershed that demonstrate a public private partnership (PPP).

<b>Institutions→ Activities↓</b>	<b>Community and their institutions</b>	<b>VDC/ Municipality</b>	<b>DDC/line agencies</b>	<b>NGOs</b>	<b>Private Sector</b>
Promotion of minimum tillage operation	Implementing	Planning	Technical support (DADO, DSCO, DFO)	Technical support	Marketing of the products
Plantation in the degraded and eroded land	Implementing	Planning	DFO and DSCO (seedlings provide) and awareness raising	NGOs will also support seedlings	
Construction of check-dams	Implementing	Financial support	Financial and technical support	Financial and technical support	
Protection of water sources	Implementing	Planning and support	Technical and financial support	Technical and financial support	

## **4. ANALYSIS: TOWARDS DEVELOPING AND IMPLEMENTING A LAPA**

### **4.1 INCLUDING CLIMATE FORESIGHTS INTO LOCAL DEVELOPMENT PLANNING**

Raising awareness about climate change and its consequences can facilitate integration of climate foresights into local planning. In addition, improved access to climate information and capacity building through local schools can potentially contribute to include climate foresights in local planning. Such documentation contributes to facilitate poor and vulnerable communities to prioritize their adaptation needs.

In the circumstance of NAPA preparation and its implementation, formulation of LAPAs and its efficient and effective implementation is crucial for climate proof local and national development. In order to include climate foresight in local planning, the proposed LAPA design should covers all aspect of climate vulnerability and adaptation options. This can be achieved through a thorough analysis of climate and livelihood context of the given area from climate change perspective.

LAPAs will only be formulated and implemented to reach the vulnerable communities if it follows participatory, transparent and top-bottom and bottom-top planning and assessment approaches. The learning and experiences generated from LAPAs provide important feedbacks to the local and national development plans, programmes and policies. So, the mechanism of monitoring and evaluation should not be considered as seen in the present regular development plans and programmes. Since we are implementing the national program (NAPA) through local plans representation of local people in monitoring and evaluation should ensure delivery of finance and services locally. This process will also build capacity of stakeholder on climate change issues.

### **4.2 ASSESSING VULNERABILITY**

Participatory assessment of climate risk and hazards and their impact on livelihood resources of the communities is an important tool that needs to be considered while designing LAPA. Assessment of climate vulnerability and community based strategies can be achieved through social tools including time line, crop calendar, impact and vulnerability matrix, and assessing the access to and control over the livelihood resources by the communities, etc. The participatory tools and techniques such as historical time line, hazard mapping, seasonal calendar, crop calendar, vulnerability matrix, and impact and adaptation option analysis framework.

### **4.3 PRIORITISING OPTIONS**

Cost benefit analysis combined with multiple criteria analysis was used to identify and prioritize adaptation needs. Before doing cost benefit analysis, the long list of adaptation options were prioritized by matrix or pair wise ranking from the perspective whether these significantly contribute to reduce the impacts of climate change in the watershed. After the cost benefit analysis, gender sensitivity and addressing poor and marginalized community

were the multiple criteria to prioritize the adaptation options as mentioned in the table 4 and 5 below.

Table 4. Cost benefit analysis of the prioritized adaptation options for watershed management in the pilot in 2010

Cost Benefit→ Activities↓	Cost (0-5)				Benefit (0-5)				B/C
	Environ	Economic	Social	Total	Environ	Economic	Social	Total	
Promotion of minimum tillage operation	0	2	1	=3	5	4	4	=13	4.33
Plantation in the degraded and eroded land	0	3	1	=4	5	5	5	=15	3.75
Construction of check-dams	1	5	3	=8	5	4	4	=13	1.62
Protection of water sources	0	4	3	=7	5	5	5	=15	2.14

Table 5. Prioritization of adaptation options for watershed management by using multiple criteria along with cost benefit analysis in the pilot in 2010

Criteria→ Activities↓	B/C	Gender sensitivity	Reaching poor and vulnerable	Total
Promotion of minimum tillage operation	4.33	4 (saves time and reduce drudgery)	4 (technologies can directly reach)	=12.33
Plantation in the degraded and eroded land	3.75	4 (saves time and reduce drudgery)	2	=9.75
Construction of check-dams	1.62	1	1	=3.62
Protection of water sources	2.14	3 (saves time and reduce drudgery)	3 (ensure water availability)	=8.14

This tool was found effective from two perspectives. First, it saves time and money to prioritize adaptation options in a participatory discussion with community members, where community member can identify potential partners to support to those activities that cost high. In addition it is useful for them to prioritize other developmental activities with some rational basis. Second, it also provides a quick and dirty analysis of prioritizing services in the community by outsider organizations such as NGO, private sectors and line agencies. However, it needs enhanced capacity for communities to make a cost estimate and benefits for longer periods.

## 4.4 SERVICE AND FINANCE DELIVERY MECHANISM

With due consideration of NAPA implementation framework, experience of the pilot and that of LIBIRD, implementation of local adaptation actions should be based on ground reality. The mechanism should engage all local stakeholders and it must include district and village level governmental agencies, community based organizations, private sector and nongovernmental organizations demonstrating a public private partnership (Figure 2). It should define the specific roles and responsibilities (i.e. services) that each partner should take into account to provide their services.

There should be a two way delivery mechanism of service in order to really enhance the adaptive capacity of the poor and climate vulnerable communities and the ecosystems. It means that the mechanism should play a vital role in establishing the market linkage of the produces and increasing the access of vulnerable people of the given unit to the basic services and service providing institutions. Primarily, the service providers in one way must directly work with the community and their organizations to carry out or implement the specific adaptation actions and on the other way, they must involve in building the capacity of community institutions which can become the entry point and who are the primary implementer of the adaptation actions.

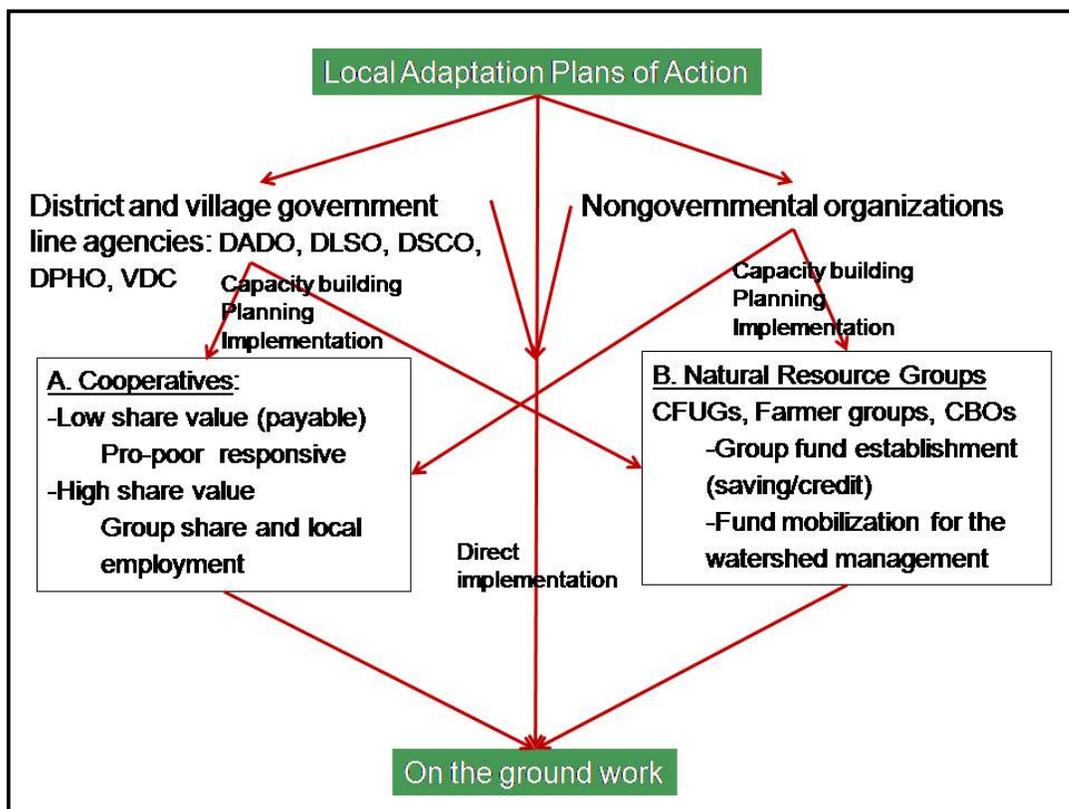


Figure 2. The proposed mechanism of service delivery of the local adaptation plans of actions.

In the given watershed, LAPA can be implemented by following the two types of community institutions. One way of delivering services is through cooperative model and the other way is through natural resources groups. In the former model, the community organizations such

as cooperatives can become one of the entry points for LAPA implementation. In addition cooperatives have established a unique mechanism that included poor, disadvantaged and vulnerable members in their marketing schemes. So, this pathway could provide an access to the poor and marginalized member of the community. Furthermore, this model plays vital role to link outcomes with the market since access to market and income generation by selling of local produces enhances the adaptive capacity of poor and climate vulnerable communities. In the later model, the adaptation actions that are associated with resource management (natural resources and agriculture) should be entered through the resource management groups such as community forest user groups, farmers groups, women's groups, mixed groups, and youth clubs. This model also provides opportunity to reach the resource poor community members to include them in adaptation mechanisms. These two modalities of LAPA implementation can cover all existing institutions working in the given unit of implementation and helps bring a synergistic association among them. It helps to enhance the access of poor and marginal people to the market, information, institution, technology and resources to adapt to climate change.

#### **4.5 MONITORING AND EVALUATION FRAMEWORK**

In order to ensure an effective (in the sense it reaches to the climate vulnerable people, areas and systems) and efficient (in the sense it delivers quality output for the enhancement of adaptive capacity of those people and resilience of those areas and systems) implementation of adaptation interventions, a bottom-up as well as top-down monitoring and evaluation mechanism should be in place and operate in equilibrium. The learning generated at the bottom is important for national policy and programmes, meanwhile the scientific and technical backstopping from the top are critical for effective and efficient implementation.

In this context, based on LI-BIRD's service and finance delivery mechanism, a two-way mechanism of monitoring and evaluating the LAPAs is recommended by this pilot (Figure 3). In order to ensure 80% fund flow to the local level as well as coordinate LAPA preparation and implementation, a national level steering committee is needed to mainstream local experiences and learning on adaptation into national plans, policies, and programmes.

The district level adaptation steering committee must be at district level to coordinate with center and local stakeholders. This is vital for monitoring and evaluation of the adaptation programmes in the district (should also be responsible at municipal level). Based on the experiences and learning at the local level, it can influence district line agencies and non-governmental organizations to integrate the climate adaptive responses into their plans and programmes.

The local level committees, whether at the VDC or watershed level, are recommended for implementation of the LAPAs in the local level. They are responsible for mainstreaming adaptation responses in the VDC periodic plans as well as that of community institutions. In a nutshell, these committees are responsible for creating an enabling environment from national to local level for effective and efficient implementation of LAPAs.

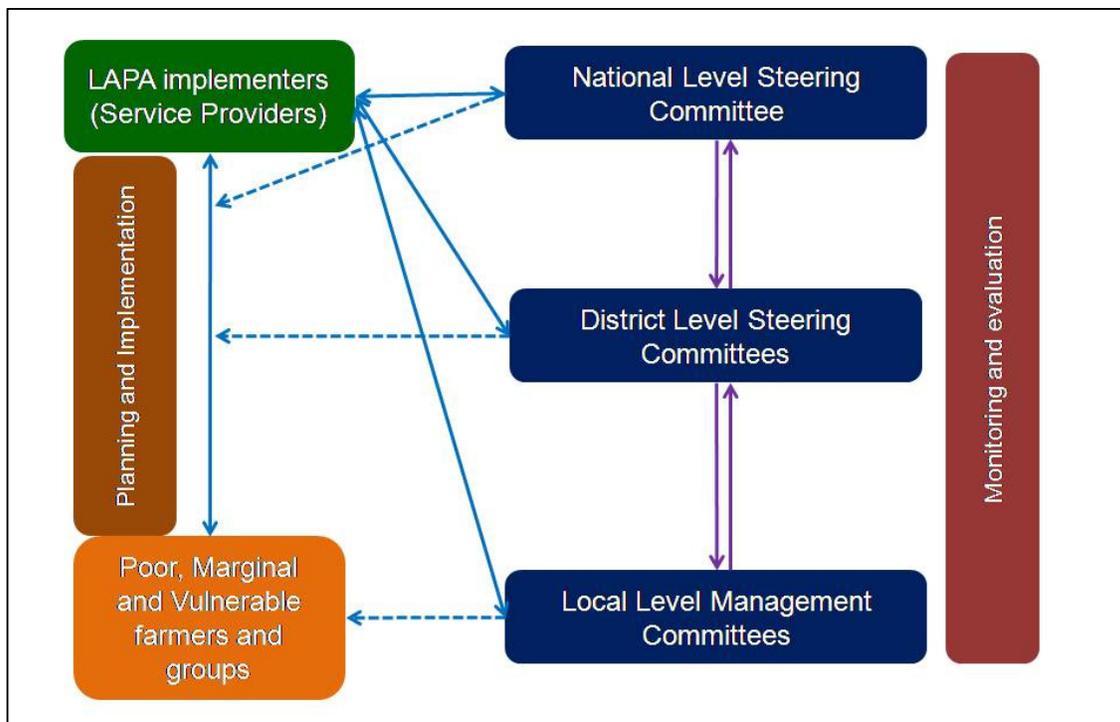


Figure 3. The proposed monitoring and evaluation framework of the local adaptation plans of action (Modified from monitoring and evaluation mechanism of LI-BIRD)

Under these national to local level committees, a monitoring and evaluating team need to be formed or the existing group is given this assignment to ensure LAPA are effectively planned and implemented. It must be able to provide technical and managerial input to the LAPA development process and those that facilitate implementation. It must also ensure information from monitoring and evaluation feeds back into planning cycles. The team should engage expertise in various themes such as from technical and managerial expertise. For example, the team may comprise of one community member, VDC secretariat, Planning Officer from District Development Committee, Municipality, experts from district agriculture, forestry, soil conservation, health, and irrigation offices (including district level committee), and member from the national steering committee. During this process, if the team becomes larger, then the members can be involved alternately. The team can use the logical framework analysis of the LAPAs and service providers as a monitoring and evaluation mechanism. Based upon the logical framework of LAPAs and that of service provider, the monitoring can be done at activity, process and output level, whereas evaluation can be done at outcome level to measure the changes made through the implementation in enhancing the adaptive capacity of the vulnerable communities.

#### 4.6 WATERSHED OR SUBWATERSHED AS A UNIT OF LAPA

One of the important recommendations of the pilot is watershed or sub-watershed as a unit of LAPA in which what we mean 'local'. A watershed or sub-watershed cut across the administrative boundary such as districts or VDCs or municipalities. However, it shares a similar culture in terms of society and agriculture. Traditionally, there is a socio-cultural association between the communities of the watershed in terms of bartering goods and services. The natural resources of the watershed and the ecosystem services provided by

the watershed are in one or the other way is related to every member within the watershed. The integrity and unity among the watershed communities also generates a better access to the market, information and service providers.

Under each watershed, LAPA can be implemented by mainstreaming the relevant adaptation priorities to the planning process of the VDCs and or municipalities and or districts. Though the unit can be a watershed, LAPA can make an entry for its implementation through VDC.

From the perspective of watershed management in response to the impacts of climate change, ecosystem based adaptation and integrated management of agriculture, water, forest and biodiversity sectors through community based adaptation, and sustainable management of water resources are the urgent and immediate adaptation options as identified by Nepal's NAPA. Working at watershed level addresses the similarity vulnerability contexts thereby generating wider impacts on the livelihood of vulnerable communities with optimizing cost and benefits. In this context, based on our pilot and LI-BIRD's experiences, the unit of LAPA should be watershed or sub-watershed to optimize efficiency and cost of implementation, generation of wider impacts, and enhancing the adaptive capacity of the ecosystem and communities.

#### **4.7 GAPS TO DEVELOPING AND DELIVERING LAPAs**

- i. A thorough review of existing national policy and plans need to be carried out to add climate foresights into these. On that basis, those policies and plans should be refined by fulfilling the gaps on the issues of climate change. It will also facilitate integrating climate change responses in the district and local planning process.
- ii. A top-down and bottom up planning process needs to be made while designing LAPA rather than top down or only bottom up. It should start with community adaptation needs, and identification of their roles and the roles of key stakeholders. Through this local ownership can be ensured.
- iii. Since the political context of the country is in transition and in the context of rapid changing government and its related professionals, formulation and implementation of LAPAs become difficult if an understanding of climate change, NAPA, and LAPA is not clear at the national level. In order to avoid such constraints, the political leaders, constitution assembly members and policy makers need to be regularly updated on climate change progresses, the need of LAPAs and NAPA implementation.
- iv. In the context of non-functioning VDC structures, the service delivery mechanisms and monitoring and evaluation mechanisms could be effective to operationalize the LAPA and implement NAPA in partnership with private sector organizations.
- v. Capacity building of stakeholder (local to regional and national level) on climate change issues is very important to effectively and efficiently make LAPAs and implement these. The framework and the delivery mechanism along with trained human resources needs to be prepared to translate policies into action. This needs to be taken into consideration while designing and implementing LAPA in our context.

## **5. CONCLUSION**

Based on the outputs and analysis of this pilot, the following approaches, tools, practices, coordination mechanism, institutional mechanisms and financial mechanisms are recommended for designing LAPA in a watershed or a sub-watershed (Figure 4).

### **5.1 APPROACH**

The overall development of LAPA should follow a participatory and multi-partnership approach. It must ensure the participation of local communities and their institutions at every step of planning and implementation. The vulnerable communities identified during climate risk assessment must be central during planning and implementation of LAPA. In addition, the planning and implementation of LAPA needs to be based on livelihood assets (natural, physical, social, financial and human assets) and it must include options and mechanisms that diversify the use of these resources and increase the access of vulnerable communities.

### **5.2 TOOLS**

- i. Different participatory tools and techniques can be used to identify the current and future climate hazards, their risks and impacts, and current and potential adaptation options. These include historical time lines, hazard mapping and prioritization, seasonal calendars, cropping calendars, vulnerability matrix, and impact and an adaptation option analysis framework. The climate and livelihood context of the area can be assessed by using CRiSTAL.
- ii. In order to assess the access of communities to livelihood assets and basic services, the gateway system concept is useful. Gateway system analysis, if done with active participation of local decision makers, can be used to inform adaptation planning and inclusion of marginalized people in planning and implementation of activities that increase local resilience to climate effects.
- iii. Cost benefit analysis along with multiple criteria ranking is also a useful tool to prioritise implementation of identified adaptation options and develop synergy among the stakeholders. Based on this analysis, communities and local planners can distribute the roles and services to each stakeholder including communities. For example, they can take assistance from outsiders (NGO, government line agencies, etc) to those interventions that bear high cost and high benefit, which they cannot afford. For interventions having less cost and high benefits, local communities can initiate them and also can match activity with outsiders.

### **5.3 TECHNOLOGY AND PRACTICES**

The following technologies and practices are recommended to be integrated into the LAPA at watershed level.

#### Adaptation strategies related to natural resources

- i. Reforestation of degraded and eroded lands and plantation of fodder trees on public and eroded land (for long term investment),
- ii. Construction of gabions and loose stone check dams or split bamboo barriers (for short term investment)
- iii. Bioengineering practices for gully control and control of soil erosion

- iv. Promotion of minimum tillage operation
- v. Protection of water sources

#### Adaptation strategies in agriculture

- i. organic farming
- ii. agroforestry farming systems
- iii. Integration of legumes in rain-fed or upland farming systems
- iv. cultivation of crops developed by participatory plant breeding and participatory variety selection
- v. Cultivation and marketing of non timber forest products to diversity livelihoods and utilize marginal lands
- vi. Conservation of local crop varieties through seed banks and field gene banks
- vii. Identification and promotion of climate stress tolerant underutilized crops in the farming system
- viii. Integration of fruit in the farming system
- ix. Integration of small farm animals and their local breeds in farming system
- x. Identifying and promoting climate proof income generating activities

### **5.4 SYNERGY**

Every actor including each household of the watershed should be engaged in design and implementation of LAPA. It also requires national guidance and support. At national level there should be a national steering committee. A coordination committee at district or watershed and at VDC level should be in place to monitor and evaluate the outputs and outcomes of LAPA. A public private partnership should be demonstrated during LAPA development and implementation that can develop synergy among the stakeholders in the given watershed and link its services and products to the market or outsiders.

While designing and implementing LAPAs, it is very important to define whether the local unit is at VDC, district, watershed or sub-watershed level. LIBIRD recommends, from pilot and wider experience, a watershed or sub-watershed as the main unit of LAPA. This is recommended as appropriate for cost effective planning and implementation of the adaptation strategies, for good representation of the strategies that address vulnerability, and for integrated management of watershed services and natural resources. This will enhance the collaboration among the local institutions (government, community based and nongovernmental) operating in the watershed by developing synergistic associations to respond to the impacts of climate change. It will also ensure wide ownership of the plan and its smooth implementation.

### **5.5 INSTITUTIONAL MECHANISMS**

- i. LAPA should integrate a reciprocal benefit sharing mechanism between upstream and downstream communities to initiate and sustain management of ecosystem services from a climate adaptation perspective. It can increase access of community to market and brings about livelihood and social change.
- ii. A synergistic association of community organizations and development of social cohesion is important for LAPA development and implementation and can be brought about by defining clear roles and responsibilities. Assigning separate roles to separate

- groups for management of ecosystem resources is fruitful and effective to develop ownership.
- iii. Institutions can support adaptive capacity through promoting group funds (micro-credit) to mobilize communities around climate adaptation and develop ownership to the interventions implemented.
  - iv. Institutions should promote private sector involvement to establish market opportunities for the products from the community as this is crucial to adapt to the impacts of climate change through value addition, tourism, and information access.

## 5.6 FINANCIAL MECHANISMS

Under the supervision and coordination of district and local level committees, LAPA financing should reach vulnerable communities from service providers (government line agencies, NGOs and private sectors) by two paths. One is through local cooperatives that operate to mobilize funds and market their products. The other is through natural resource management groups that operate to conserve and manage natural resources of the locality for sustainable livelihoods.

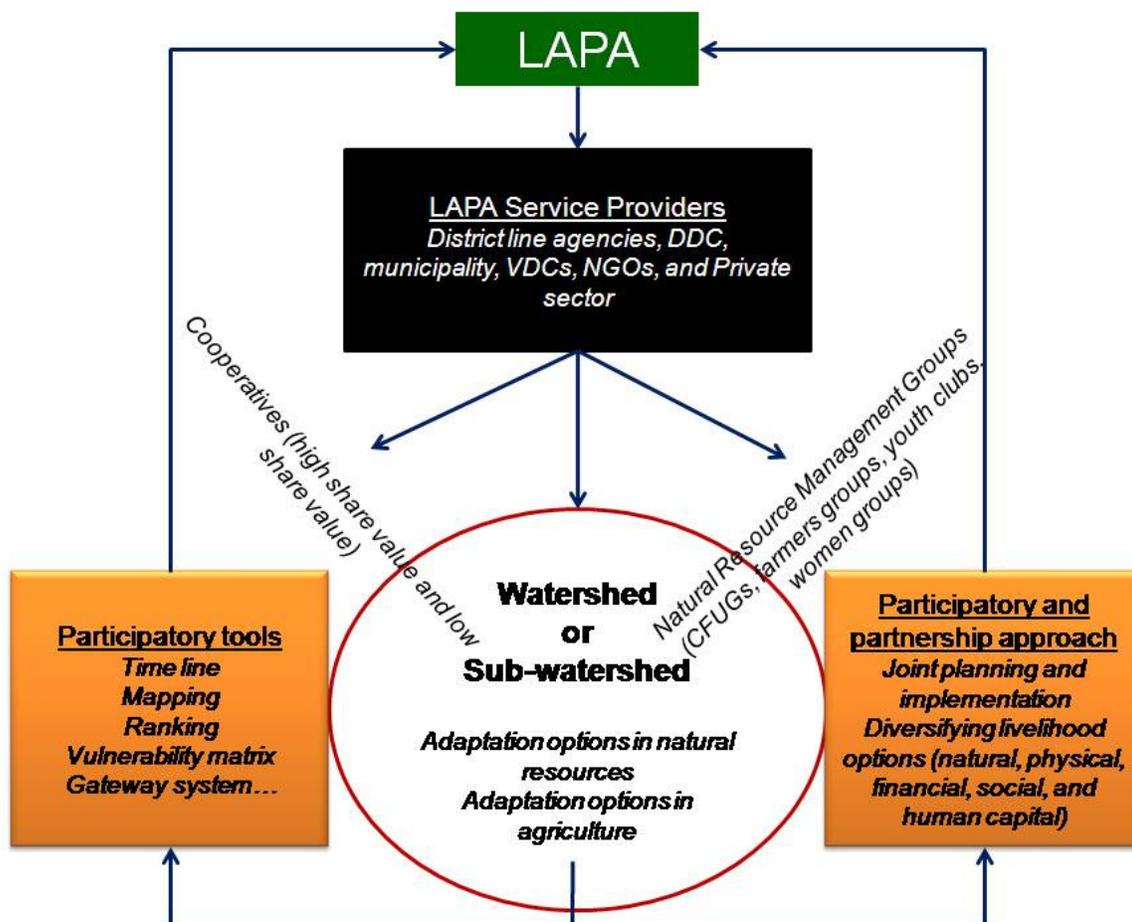


Figure 4 A prototype of LAPA at watershed level demonstrating tools, approaches, and service delivery mechanism.

## REFERENCES

FAO. 2010. The Hague conference on agriculture, food security and climate change “Climate Smart” Agriculture: Policies, Practices and Financing for food security, adaptation and mitigation

IPCC.2007. Climate change 2007: Synthesis report. An assessment of the Intergovernmental Panel on Climate Change

IUCN, IISD, SEI, Interco-operation. 2007. CRiSTAL :Community-based Risk Screening – Adaptation and Livelihoods. Users’ manual. A decision support tool for assessing and enhancing project impacts on local adaptive capacity to climate variability and climate change. Version 3. November 2007

Kafle G., M. Cotton, J. R. Chaudhary, H. Pariyar, H. Adhikari, S. B. Bohora, U. Chaudhary, A. Ram and B. Regmi. 2008. Status of and Threats to Waterbirds of Rupa Lake, Pokhara, Nepal. *Journal of Wetlands Ecology*. 1(1/2):9-12.

MOE. 2010. National adaptation programme of action (NAPA) to climate change. Ministry of Environment, Government of Nepal, Kathmandu, Nepal

Pradhan, N., I. Providoli, B. Regmi and G. Kafle. 2010. Valuing water and its ecological services in rural landscapes: A case study from Nepal. *Mountain Forum Bulletin* Page 27-29. Downloaded from [http://www.mtnforum.org/rs/bulletins/counter\\_bul.cfm?bID=31](http://www.mtnforum.org/rs/bulletins/counter_bul.cfm?bID=31) [retrieved on 24 Jan 2011]

Regmi, B.R., G. Kafle, A. Adhikari, A. Subedi, R. Suwal, and I. Poudel. 2009. Towards an innovative approach to integrated wetland management in Rupa Lake Area of Nepal. *Journal of Geography and Regional Planning* Vol. 2(4), pp. 080-085, April, 2009. Downloaded from <http://www.academicjournals.org/jgrp/PDF/PDF%202009/Apr/Regmi%20et%20al.pdf> [retrieved on 24 Jan 2011]

Neopane, S.P., K. Thapa, R. Pudasaini, and B. Bhandari. 2010. Livestock: an asset for enhancing adaptive capacity of climate vulnerable communities of Nepal. Paper presented in the Consultative Technical Workshop on Climate Change: Livestock Sector Vulnerability and Adaptation in Nepal organized jointly by Nepal Agricultural Research Council (NARC), International Livestock Research Institute (ILRI), Heifer International (HI) Nepal, Local Initiatives for Biodiversity, Research and Development (LI-BIRD), and Ministry of Agriculture and Cooperatives (MoAC), Government of Nepal. Kathmandu, Nepal. (In Press)

## ANNEX 1

### **Action Plan for Rupa Lake Management and Development**

During the piloting stakeholders at community and district level were involved to participatory develop conservation and management action a plan of Rupa lake including lake, wetland and watershed area. The details of Rupa lake and watershed management action plan to minimize existing problems are given below-

#### Action plan for lake management

- Plantation in lake shoreline and vicinity of the lake area
- White lotus conservation in Bimirekuna and Chatrepang and initiate its marketing.
- Local fish diversity conservation at Kharbari Tunda.
- Breeding habitat conservation of local fish, Sahar at Inlet of Rupa Lake.
- Market management of local and improved fishes
- Lake cleaning (water hyacinth, water chestnut, Kalo jhau, wooden logs)
- Identification, documentation and conservation of lake biodiversity.
- Implement management activities in a participatory way which involves representation from lake and watershed communities (eg. Ama Samuha, Local Clubs, organizations etc).
- Dam construction.
- Canoeing and boating to promote tourism
- Construction of suspension bridge at Sangre
- Sedimentation pond construction at lake inlet

#### Action plan for wetland management

- Lake area demarcation on the basis of survey carried in 2032 BS (take initiatives for the lake demarcation in coordination with local government body and community)
- Alternative management planning for encroached upon land.
- Green belt (Suitable grass plantation- Narkat, Bains), foot trail and resting place construction around Rupa lake to promote tourism
- Wild rice conservation block
- Improve habitat of birds
- Controlling grass bulks at Jamankuna and Saathi for declaring the places as conservation area
- Declaring hunting restriction sites around lake
- Identification, documentation and conservation of wetland biodiversity.
- Wetland biodiversity information centre establishment
- Promote publicity and research

#### Action plan for watershed management

- Plantation at landslide and erosion prone areas and stream banks by providing fodder/forage and grasses (eg *Amriso*) in watershed area.
- Terrace improvement and hedge row planting

- Stream bank and gully control at Bhangarakuna, Sano and Thulo Phadi, Teenmule, Bandre, Rumto, Kathebangro, Jimire and Kuna khola through Bio-engineering and biological check dams
- Coordinate and linkage with stakeholders and other line agencies for constructing check dam
- Implement IG activities like coffee cultivation, bee keeping, goat rearing, amriso, Jai grass, Nigalo, Bans, fruits and vegetables cultivation.
- Orchid and medicinal plants cultivation and market linkage
- Trainings on IGA, sustainable agriculture development system
- Encourage for rationale use of bio-fertilizers and bio-pesticides and create awareness on hazardous effects of chemicals in the environment and lake ecosystems
- Control over the household garbage and manage it towards compost making
- Control overgrazing and stop open grazing around the stream and lake shoreline.
- Mobilize Forest users group in conservation
- Extend Rupa lake conservation and management awareness program in watershed area
- Promote village tourism

### Others

- Implement programs that increases awareness on conservation and encroachment
- Educating school children on lake management and conservation
- Develop management strategy to implementing activities through committee formulation with involvement of various local institutions
- Network of Government and non-government organizations

## ANNEX 2

### Activities that LIBIRD would carry out to build on the work of the pilot.

S.N.	Further LAPA Development Activities	Theme (Watershed/Agriculture)
1	Bioengineering for gulley control and control of soil erosion	Watershed
2	Promotion of minimum tillage operation	Watershed
3	Protection of water sources	Watershed
4	Construction of gabions and loose stone check dams or split bamboo barrier (for short term investment).	Watershed
5	Plantation in the degraded lands	Watershed
6	Organic farming	Agriculture
7	Legume integration and promotion	Agriculture
8	Promotion of stress tolerant species	Agriculture
9	Running a CADSchool	For capacity building
10	Group share and group fund to poor and marginalized community members	For capacity building and mobilization
11	Cultivation of NTFPs in marginal lands	Watershed/Agriculture