A Field Study Report on

Identification of Indigenous, Eco-friendly and Climate-resilient Agricultural Practices in Nepal

Improving Food Security Governance in South and South East Asia through Strengthened Participation of the Organizations of Marginalized Farmers (*Regional Food Security Governance*) Project

LWF Nepal

2017

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Foreword

I am happy to share with you the Field Study Report on "Identification of Indigenous, Eco-friendly and Climate-resilient Agricultural Practices in Nepal" which abbreviates the proven indigenous, eco-friendly and climate-resistant farming practices by farmers in the project districts under "Improving Food Security Governance in South and South East Asia through Strengthened Participation of the Organizations of Marginalized Farmers (briefly known as Regional Food Security Governance) Project". Food First Information and Action Network (FIAN) Nepal along with the project's implementing partners Nepal National Dalit Social Welfare Organization (NNDSWO), Banke; Forum for Awareness and Youth Activities (FAYA), Kailali; Feminist Dalit Organization (FEDO), Doti and Dalit Welfare Organition (DWO), Achham.

LWF Nepal, a member of ACT Alliance, prepared the report and brought to this shape with financial support from the European Union and DanChurchAid. LWF Nepal coordinated with involved farmers, and stakeholders for constructive engagement to initiate the process by establishing Demonstration Plots (served as farmer's field school) with the support of selected farmers of the project areas. Technical assistance for executing the demonstration plots were received from respective District Agriculture Development Office (DADO) and Agriculture Service Center (ASC). And technical inputs were received from National Agriculture Council to validate the results. This work could not have been possible without active engagement of stakeholders and member organizations.

This report is the result of hard work and dedication of all involved people/representatives of thematic member originations, implementing partners, associate partners and technical partners of the project along with the editorial team, reviewers, etc. Therefore, thanks go to Mrs Mauly Benergy and Dr Arnav Roy of CES,

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I would like to thank our other staff, rights holders, implementing parners, donors and stakeholders including government agencies for their contribution to the earlier versions of the manuscript during the whole mapping process at different times and stages. The errors are ours.

Dr Prabin Manandhar
Country Director
LWF Nepal

Contents

1. Background Information

1.1 Executive Summary

LWF Nepal along with other implementing and associate partners has been implementing 'Improving Food Security Governance in South and South East Asia through Strengthened Participation of the Organizations of Marginalized Farmers' Project with financial support from European Union and DanChurchAid. The report is an integral part of the project with an objective of increasing engagement of the target groups/networks in relevant national/regional/global fora to protect and promote indigenous, eco-friendly farm practices and farmer interests. It is focused on identifying the indigenous, eco-friendly and climate-resilient agriculture practices/technologies by establishing demonstration plots on replicable practices.

The report has been organized into chapters like executive summary, introduction, rationale of the establishment of demonstration plots, methodology, study area, achievement/ outcomes, conclusion and recommendations. The report highlights the key indigenous, eco-friendly and climate-smart farming practices. It also illustrates the narrative of successful cases from the project districts.

Eco-friendly, indigenous and climate-resilient agricultural practices are cost-effective and can easily be carried out by the poor or small farmers using available resources, tools and farming technologies. It is, therefore, crucial to demonstrate and promote identified and selected indigenous farming practices in the project area. The results of the demonstration plots, their dissemination and replication will serve as an evidence for advocacy. In reference with the evidences, the target groups will advocate for their registration, certification, and promotion through proper and regular allocation of budget by the government in its plans and programs. The collective voices of a large number of target population is needed for influencing state policies.

LWF Nepal has prepared this report as part of the Regional Food Security Governance project in collaboration with the European Union, DanChurchAid, and the Government of Nepal. It highlights the process and successful results of identified indigenous farming practices and proves them as eco-friendly and climate-resilient agricultural practices for sustainable agricultural production. The report expects for extension of the findings of the study from concerned audiences and government authorities for achieving environmentally sound agriculture and ecosystem.

1.2 Introduction

Agriculture in Nepal has long been based on subsistence farming, particularly in the hilly regions where peasants derive their living from fragmented plots of land cultivated in difficult conditions. The economy is dominated by agriculture in Nepal. According to the World Bank, agriculture is the main source of food, income, and employment for the majority of people in Nepal. Since the formulation of the Fifth Five-Year Plan (1975–80), agriculture has been accorded the highest priority because economic growth was dependent on both increasing the productivity of existing crops and diversifying the agricultural base for use as industrial inputs. The production of crops fluctuated widely as a result of the factors like weather conditions, land reclamation for settlement, environmental degradation and ecological imbalance resulting from deforestation. Although new agricultural technologies helped increase food production, there was room for further growth. Population increment and environmental degradation have ensured that the minimal gains in agricultural production, owing more to the extension of arable land than to improvements in farming practices, have been cancelled out. Once an exporter of rice, Nepal now faces food deficit.

Nepal has more than 50% of people engaged in agriculture. According to the International Labor Organization, 68% of Nepal's population is employed in the agriculture and forestry sector, accounting for 34% of the gross domestic product (GDP).

Nevertheless, Nepal struggles to produce an adequate supply of food for its citizens. According to Statistical Information on Nepalese Agriculture (2008/2009), only 65.6% of people depend on agriculture and 21% of land is cultivated and 6.99% uncultivated. Agricultural production accounted for about three-fourths of total exports in the late 1980s and most exports consist of primary agricultural produce which goes to India. Increased agricultural activity has placed tremendous stress on the fragile ecosystems of the mountains, with severe deforestation leading to erosion and flood that threaten the livelihood of farmers throughout the country.

Our agricultural programs are sustainable in two senses:

1. Long-lasting: The knowledge gained will never be lost; benefits last indefinitely. 2. Eco-friendly: We emphasize the use of organic methods, such as non-chemical pest control techniques and composting for fertilizer. It is therefore crucial to demonstrate and promote these practices in the project area. The demonstrations, dissemination and replication of such practices by farmers will serve as evidences for advocacy. On the basis of these evidences, the target group will advocate with the government to promote these practices and to adopt them in its plans and programs. The five-year project titled 'Improving Food Security Governance in South and South East Asia through Strengthened Participation of the Organizations of Marginalized Farmers' has been implemented in Bangladesh, India, Myanmar and Nepal with the financial support from European Aid and DANIDA/DanChurchAid to increase engagement of the target groups/networks in relevant fora to protect and promote indigenous, eco-friendly farm practices. The agro-ecological methods are critical for long-term food security. Therefore, the action will document, demonstrate and disseminate the indigenous farm practices to promote their replication among target communities and avocate for effective eco-friendly and cost-effective agricultural policies for small and marginal farmers. In effect it will also contribute to protecting and

promoting environment by reducing negative impact on natural resources i.e. water, soil, flora and fauna in the local eco-system.

1.3 Rationale

Despite significant improvements in recent years, Nepal still remains as a highly food-insecure country. Estimates suggest that approximately 38% of the country's population is energy-deficient (NPC and CBS, 2013). Nepal is influenced by the summer monsoon, and agriculture is predominantly rain-fed depending heavily on monsoon rains (Shrestha et al., 2000). Increasingly erratic rainfall patterns over the last few decades (Parthasarty et al., 1992; Staubwasser et al., 2002) and a perceived decline in precipitation, especially in food-deficit areas after the 1960s (Kothyari and Singh, 1996), suggest that continued climate variability could have a detrimental effect on food security in Nepal.

The Nepalese agriculture is characterized by subsistence farming and a few people own and control vast tract of the cultivable land. Most of the country is mountainous, and there are pockets of food-deficit areas. The difficulties in transportation make it far easier to export surplus food grains to India than to transport to the remote mountain regions within Nepal. A considerable population of cattle, goats, and poultry exists, but the quality is poor and they produce insufficient food for the local consumption.

Land ownership concentrates on the hands of landlords who contract out to tenant farmers. Increased productivity may have been suppressed by such a system. Even though the legal mechanisms for land reform (such as placing limits on the amount of land owned) do exist, in practice most farmers still have pitifully small holdings. Predictably, land reform has been the mandate of every political party in Nepal. Farmers have limited access to improved seeds, new technologies, and market opportunities. Declining agricultural production has depressed rural economies and increased widespread hunger and urban migration.

Food insecurity and malnutrition are very common. The prevalence of famine in Nepal is 13%.

Rapid growth in population, increased food and fiber demand, cropping intensities, as well as changes in food habits, demographic trends and land use have led to the exploitation of and imbalance in the agro-ecosystems. An integrated approach including various technological practices is required to ensure the sustainability of farming. To increase the supply of agriculture production, new technology is being used. This includes genetic modification, chemical fertilizers and synthetic pesticides in agriculture. The use of chemical provides instant benefits but in the long run these chemicals destroy the productive capacity of soil. Simultaneously, the genetic modification of the food is also decimating the natural variety of plants. On other hand, urbanization, industrialization and development of various other infrastructure have led to the rapid loss of agricultural land and decline in production.

1.4 Indigenous, Eco-friendly Farming Practices

Indigenous knowledge systems are the complex arrays of knowledge, know-how, practices and representations that guide human societies in their innumerable interactions with the natural milieu: agriculture and animal husbandry; hunting, fishing and gathering; struggles against disease and injury; naming and explaining natural phenomena; and strategies for coping with changing environments (Douglas Nakashima and Marie Rou´e, 2002). Local and indigenous knowledge refers to the understanding, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. Eco-friendly farming practices are farming systems that promote environmentally, socially and economically sound production of crops. With respect to natural capacity of plants, animals and local conditions, it aims to optimize quality production in all aspects of agriculture and the environment.

Practices are the most efficient (least amount of effort required) and effective (best results) ways of accomplishing a task, based on repeatable procedures with proven value. This project focuses on support activities, including promotion of demonstration plots in indigenous farm technologies, disaster- and climate-resilient agrcultural practices to provide practical knowledge to the target groups as well as collect evidences of good practices to feed into policy dialogues. Promoting practices in neighboring areas and seeking policy support for loan, subsidy, advance training, access to market, and technological assistance for soil and water conservation, etc. Identification of indigenous, eco-friendly agriculture practices and building their demonstration plots for replication to a wider scale focusing on poor, landless and small farmers is one of the key activities of the this project. Indigenous, eco-friendly, disaster-resilient agriculture practices are cost-effective that lead to food security at household level of the resource poor or small farmers.

Indigenous practice is often taken as a tool to recognize and promote the local and indigenous knowledge that has gradually been lost over the time. There are many indigenous knowledge and practices which are more socially acceptable, economically viable, environmentally sound and sustainable compared to the recent knowledge and practices. However, with the development of scientific and market-oriented knowledge and practices, such indigenous knowledge and practices have gradually been disappeared.

The practices using indigenous knowledge have the following characteristics:

- **Innovative:** A Practice develops new and creative solutions to the common problems of poverty and social exclusion.
- **Makes a Difference:** A Practice demonstrates a positive and tangible impact on the living conditions, quality of life or environment of the individuals, groups

or communities concerned.

- **Sustainable:** A Practice contributes to sustained eradication of poverty or social exclusion, especially through the involvement of participants.
- **Inspiration:** They have the potential to be a source of inspiration to others. A Practice could serve as a model for generating policies and initiatives elsewhere.

Agriculture and environment has a close relationship. We depend on the environment as well as agriculture and its increased production. Indigenous Technical Knowledge (ITK) is an appropriate package of technology in agriculture which is most economical and less hazardous to the environment. According to the FAO, the environment problems of developing countries are caused largely by the over exploitation of land, extension of cropping and deforestation. Increased use of pesticides especially insecticides and synthetic fertilizers are also causing environmental problems, particularly the degradation of soil fertility and the scarcity of fuel-wood. The farming practices developed and used in a locality are termed as indigenous technologies of agriculture. The Indigenous Technologies (ITs) are considered as important sources of information on the local farming systems, experiences, institutions, crop culture, etc. It has also been proved that this knowledge system plays a significant role in designing a formal and efficient extension services (Sharland, 1991).

The research focuses on the problems and potentials of indigenous, eco-friendly farming practices based on the study of demonstrations plots established in project districts. It has been found out that the consumers have increased desire to consume indigenous organic products. However, the market for these products is quite rudimentary and legal certification hasn't started. Many of the consumers are of the view that quality of the indigenous and organic products is good and that's why these products are expensive. Hill farmers in Nepal have developed

traditional practices and indigenous technologies over generations of trial and local adaptations. These technologies are possibly helpful to the small and marginal farmers and potential technical partners involved in up-scaling sustainable technologies. These practices have been in harmony with the ecosystem. Hence sustainable.

1.5 Scope and Objective

The study is an integral part of improving Regional Food Security Governance Project and one of the specific objectives of the project is to increase the engagement of the target groups, networks in relevant fora to protect and promote indigenous, eco-friendly farm practices and farmer interests. Within the framework of the project and in compliance with the objective, emphasis is given on identification of indigenous, eco-friendly and climate-resilient agriculture farming practices by establishing demonstration plots and replication of proven results among farmers. It is therefore crucial to demonstrate and promote these practices and technologies in the project area to generate some evidences.

These demonstration plots, driven of results, and their dissemination and replication by the farmers will serve as evidences for small and marginal farmers-friendly policy advocacy. On the basis of these evidences, the target group will advocate that these practices should be promoted by the government by main streaming them in policy, plans and programs. Thus, the overall objective of the study and compilation of this report is to document the results derived from demonstrations plots, their dissemination and replication by farmers as well serve as evidences for small and marginal farmer-friendly policy advocacy.

It is the limitation of the study that all the outcomes of demonstration plots from the study area might not be applicable to policy advocacy and main streaming by the government, but the achievements of the demonstration plots will be used by project for

other programming tool and shared with other actors operating in similar contexts.

2. Methodology

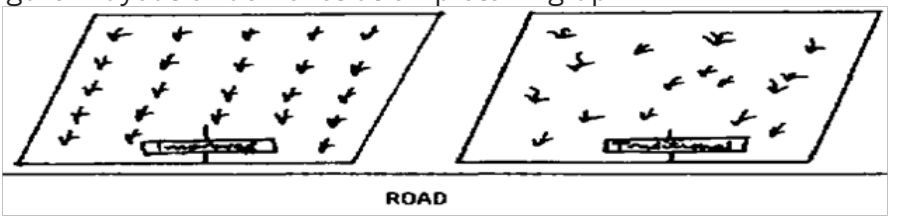
2.1 Study Area

Improving Food Security Governance in South and South East Asia through Strengthened Participation of the Organizations of Marginalized Farmers Project is being implemented in 4 districts viz. Kailali, Banke, Doti and Achham jointly by LWF Nepal, DWO, NNDSWO, FEDO, FAYA and FIAN Nepal and RtFN as associate partners. Hence, the layout and study of demonstration plots on selected indigenous practices were carried out in different VDCs/Municipalities of those districts with constant and close supervision by implementing partners.

2.2 Design of Study

The design of study on demonstration plots have been carried out systematically through layout of plots in the field, constant monitoring and record keeping and analysis of data received from field to draw results. The demonstration plots were established by implementing partners in technical guidance of LWF Nepal considering the prescribed instructions of indigenous farming practices manual prepared by LWF Nepal. The manual clearly focuses on identification, assessment and proven existing indigenous and eco-friendly farming practices in project districts. To establish demonstration plots, the farmers were oriented to the tools and techniques regarding layout and supported with seeds and other materials.

Figure: Layout of demonstration plots in graph



2.3 Data Collection Tools and Techniques

The farmers are aware of keeping the records of both qualitative and quantitative data and findings properly in given formats. The staff of implementing partners constantly supported supervision of the demonstration plots and facilitated the field process. Considering the qualitative nature of the information, a set of qualitative methods were used to analyze data. Data were collected, analyzed, various documents were reviewed and report was prepared. LWF Nepal reviewed the findings and collected relevant secondary data from different offices, and websites. The process of establishing demonstration plots was organized and supervised by respective DADO and ASC of project districts. DADO and ASC officials regularly visited field during the process. The constant suggestions from these authorities were received which enhanced the quality of outcomes of these pilots.

2.3 Data Analysis

The data, figures, and evidences from field have been collected, compiled, and analyzed by various methods and computer software for generating fact for policy discourse and replication of the effective practices. Some of the methods applied for data analysis have been discussed below:

I. Comparative (with and without) analysis

Comparative analysis is basically done for the production with before and after as well as other varieties. Production of vegetable crops from kitchen garden, riverbed farming and Tharu Aalu was taken into consideration. The data received from demos of riverbed farming, kitchen gardening and Tharu Aalu shows better results of production in comparison with similar and other varieties of vegetable crops. Farmers claimed that the yield from kitchen garden shows good result (more production with lesser-damaged by diseases and pests) after the application of compost manure, Jholmol (liquid manure), bio-pesticides, etc. prepared in previously established demenostraction.

The cost of production of both Tharu potato and true potato seed (TPS) is similar, but yield of Tharu potato is higher than the TPS. The DADO, Kailali had also observed the field and was satisfied with the yield.

II. Yield Analysis

Yield is the total outturn of the varieties cultivated in a field. The average yield from riverbed farming, Tharu Aalu and kitchen garden was found higher than hybrid varieties. This result might have been achieved due to the use of sufficient irrigation, organic manure, bio-pesticides, etc with intensive weeding, cleaning, and cropping pattern. Such as 746kg Tharu Aalu has been produced on one Kattha of land.

III. Benefit and Cost Ratio (Economic Analysis)

The demonstration plots were established using the available local resources, tools, and techniques within minimal investment. The yield achieved from these plots is more in comparison with investment. There is no application of imported inputs like chemical fertilizers, chemical pesticides, hybrid seeds, etc. which remarkably reduces the average production cost, thereby increasing the profit.

IV. Environment-friendliness Analysis (Eco-friendliness)

Use of Jholmol compost which are eco-friendly in nature must have produced healthy potato and garlic with minimal soil, air and water pollution in comparison with synthetic chemical input cultivation practice. It is helpful to maintain ecological balance due to conservation of natural beneficial organism's by the application of little amounts of chemical fertilizers and pesticides.

V. Sustainability Analysis

Soil health is improved by the use of compost which in turn will increase the productivity quality of soil for future production and enhance soil microbial activity. It is helpful for the protection and promotion of local land races for ensuring food security at future.

VI. Farmers' Analysis (Participatory Analysis)

- **Comparative analysis:** Cost of cultivation is low; benefit is higher, healthy practice of cultivation, protection and promotion of local seed varieties
- **Verbal ranking and matrix ranking:** Villagers visited the nearby farm of demo plots in order to purchase the products and appreciated the farming practices adopted by the farmers
- **Extreme weather observation (e.g. flood, drought, etc.) during demo period**: Drought condition and lack of irrigation might have resulted in decreased productivity

VII. Validation from Authority and Community

The progress of the plots is constantly monitored by district and field level Government officials for inputs and suggestions. The results were presented in related fora and feedback for betterment were received and used accordingly.

2.4 Some Empirical Achievements

Case - I Riverbed Farming, Kailali

Demonstration plots of cucurbitaceous crops in riverbed farming were established to utilize the underexploited land for generating income by marginalized farmers. Selected 7 farmers each established/demonstration plots of 2 Kattha (677 sq meters) of land. The production was an estimated 4,216kg. A total selling price of that commodity was NPR 158,930 with implicit and explicit cost of cultivation was NPR 25,850. The benefit is more in comparison with investment cost which is more profitable than other crops because of low investment with more returns from riverbeds.

Case - II Tharu Aalu Cultivation, Kailali

Demonstration plots of indigenous variety of potato (Tharu Aalu) were established using traditional farming technologies and inputs (livestock manure/compost) in Kailali. 7 farmers were selected for the establishment of demonstration plots per farmer with 1Kattha of land. The estimated production was 625kg/Kattha which was higher than the national average productivity of other potatoes i.e. 550kg/Kattha (source: National Agriculture Research Center). However, in terms of market demand and price, Tharu Aalu has higher demand than improved one due to good taste, and it also fetched higher price (NPR 50/kg) than improved potato (NPR 30/kg). In addition, according to farmers, local potato is more vulnerable to water \stress and insect and disease infestation. The cost of production of local potato (NPR 7,640/Kattha) is lower compared with improved one (NPR 10,530). Moreover, it was also found that Tharu Aalu is less susceptible to diseases and pest attack with theapplication of organic manures, bio-pesticides which isenvironmentally a good practice.

Case - III Jholmol Preparation, Achham

The demonstration plots of Jholmol has been prepared using local and indigenous farm practices and inputs such as kitchen wastage, weeds, animal urine, dung, etc. by establishing 6 plots of Jholmol. The aim of establishing demo plots is to investigate scientifically the farm practices and provide recommendation for policy change and to decrease the

dependency on chemical fertilizers for improvement of soil quality and increase in farm production. Jholmol can be prepared on a very low cost from cost-benefit analysis by using locally available materials, and it contributes to increased farm production with lesser attack of insects and diseases. These practices have worked as irrigation, manure, pest, etc.,thereby increasing the soil fertility and crop productivity. The demand and farmers' preference to suchindigenous farming technologies has been increasing. It has been found that crop production increases by 15% to 30% compared with the ones using chemical fertilizer.

Case - IV Kitchen Garden, Doti

The demonstration plots of kitchen garden were set up to produce vegetables by using indigenous seeds and farming techniques. The objective of establishing such demonstration plots is to enhance marginalized farmers' capacity so that they can adopt such farming practies in their nearby and marginal land for their subsistence needs and economic returns through commercial vegetable farming. 6 farmers were selected, mentored and equipped to establish demonstrations plots of kitchen garden. They used bio-pesticide, compost, local seed varieties with sufficient irrigation, compost manure and along with technical support from nearby ASC and DADO, Doti. The farmers had planted local varieties of vegetables such as potato, garlic, tomato, onion, cucumber, capsicum, squash, etc. with minimum investment. The average income of an individual farmer is NPR 11,500 which is more than previous average income of NPR 8,300. The increased benefit encourages farmers to promote such eco-friendly kitchen garden to generate good income sustainably.

Case - V Community Seed Bank, Banke

The demonstration plots of community seed bank have been established to conserve indigenous, local seed verities and to promote them through replication. 6 farmers were selected, supported and mentored to establish seed bank. It has been found that the level of confidence of farmers has been increased after the establishment of seed banks. Estimated 20 varieties of local and rare seeds (cereal crops and vegetables) were collected by farmers including local Saatha, Aanadi,and Kala Mansuli Dhan, local wheat, lentil, mustard, maize, garlic, ash gourd, pumpkin, cucumber, etc. About 35 farmers have collected and benefitted from the exchange of seeds from these seed banks. Farmers groups want to continue these seed banks and have planned to link them with nearby cooperatives.

Case - VI Local Bio-char, Doti

The demonstration plots of local bio-char were established by 6 selected farmers in Doti considering its beneficial impacts. It has been proved beneficial for improving soil condition for nutrient uptake by plants. Bio-char offers the chance to turn bio-energy into a carbon-negative energy.

The demonstration plots of kitchen garden used bio-char made in specifically designed metal stove by using locally available

dried leaves, twigs and small wooden pieces for vegetable production.

The bio-char can be used for cooking purpose and as manure. The produced bio-char was applied in soil inside the greenhouse and it was found that it increased production of vegetables. The results showed that the higher the production with better taste, the lower the chances for disease/pest infestation in the vegetables. Seeing these results, nearby farmers have been encouraged to adopt and use bio-char in their kitchen gardens.

3. Result and Discussion

3.1 Key Results

Some beneficial effects and fruitful results of demonstration plots are as follows:

- The results generated from demonstration plots by using the locally available tools, seeds, techniques and traditional farm inputs were found beneficial to marginalized farmers
- The evidences of demonstration plots showed that the yield received are hygienic, eco-friendly and disease- and, pest-resistant
- It was found that the health of soil and farm production increased, thereby increasing income
- Locally available tools, inputs, technologies, seeds are affirmative to decrease the dependency of farmers on supply of them from outside
- More income can be generated from scaling up of available farming inputs, practices
- Some traditional practices like Jholmol and bio-char have no

adverse environmental effects and support as climate-smart interventions

- Extension of the beneficial aspects of these indigenous farming practices is supportive and crucial for all rural, small and marginalized farmers

3.2 Plans for Dissemination and Replication

There is a plan to disseminate and replicate these results from demonstration plots as illustrated below.

- Farmer-to-farmer extension approach (e.g. 1 farmer to 5 farmers, 5 farmers to 15 farmers, 15 farmers to 30 farmers and so on)
- Integrating into government system (policies and programs): There is a plan to facilitate for the allocation of 15% of VDC/Municipality budget for agriculture and advocacy for mainstreaming of indigenous, organic, climate-resilient and eco-friendly agriculture practices into Government's programs and plans
- Farmers-to-Government approach (e.g. capacity to influence, government monitoring, and joint monitoring/ planning)
- Media mobilization for disseminating the best results of the demonstration plots among rural and marginalized farmers

3.3 Climate Risk and Adaptation Options

Increased intensity and frequency of storms, drought and flood, altered hydrological cycles and precipitation discrepancy have implications on future food availability. The potential impacts will be on rain-fed agriculture in developing countries with chronic food problems. Habitat change is already underway in some areas, leading to species range shifts, changes in plant diversity which includes indigenous foods and plant-based medicines (Mc Clean, Colin et al., 2005). In developing countries, 11 percent of arable land could be affected by climate change, including a reduction

in cereal production in up to 65 countries, about 16 percent of agricultural GDP (FAO Committee on Food Security, Report of 31Session, 2005).

But the major crop of the project areas is paddy followed by maize, and wheat occupies more than 70 percent of total cropped area as it is a major source of livelihood of the people. Agricultural crops of these areas are influenced by seasonal characteristics and different variables of climate such as drought, rainfall, fog, humidity, etc. The extreme weather events are being experienced more frequently than ever before. The major impacts would be on agriculture and availability of water resources for agriculture and domestic use particularly in the dry season. Dense fog and chilly weather are likely to harm rice seedlings and the standing crops of potato, tomato and mustard which ease disease infestation to crops especially when the temperature falls.

Farm level analyses have shown that huge reductions in adverse impacts from climate change are possible when adaptation is fully implemented. Adaptation is the principal way to deal with the impacts of a changing climate. It involves taking practical actions to manage risks from climate impacts, protect communities and strengthen the resilience of the economy. It refers to dealing with the impacts of climate change whereas mitigation means dealing with the causes of climate change by reducing emissions. Long-term adaptations are major structural changes to overcome adversity such as changes in land-use to maximize yield under new conditions; application of new technologies; new land management techniques; and water-use efficiency-related techniques.

The following measures will be applicable for adaptation:

- Seasonal changes and sowing dates
- Different variety or species
- Water supply and irrigation system
- Agriculture inputs like fertilizer, tillage methods, grain drying, etc.

- Forest fire management, promotion of agroforestry, adaptive management with suitable species and silvicultural practices
- Identifying present vulnerabilities
- Adjusting agricultural research priorities
- Protecting genetic resources and intellectual property rights
- Strengthening agricultural extension and communication systems
- Adjustment in commodity and trade policy
- Increased training and education
- Identification and promotion of climatic benefits and environmental services of trees and forests
- Introduction of short-duration and drought-tolerant crop varieties
- Vermi-composting to organic manure production and promote organic farming
- Introduction of alternative and mixed cropping pattern
- Introduction of local varieties by sufficient irrigation
- Alternate wetting and drying technology

4. Issues and challenges

4.1 Issues:

- Lack of modern skills in maintaining seed quality and storage facility
- No government program and plans to conserve indigenous seeds, crops, tools, technologies, etc.
- Excessive flow of high-yielding hybrid varieties with immediate benefits
- Lack of proactive marketing mechanism
- Low capacity of seed harvesting, processing, grading and storage
- Lower awareness on importance of seed bank at community level
- Lack of enough funds for conservation, maintenance and

operation of identified indigenous practices

4. 2 Challenges

- Government's focus on immediate benefits through production and marketing of hybrid, genetically modified seed varieties rather than investment in research, study, promotion and conservation of indigenous seed, tools and technologies
- Local seed varieties have to compete with available genetically modified seeds
- Mainstreaming of farmers selected program and plans by government's authority
- Limited awareness on role of local seeds in food security and balancing ecosystem
- Lack of legal framework for registration and recognition at district level

5. Conclusion and Recommendations

Finally, the study concludes the results of the demonstration plots with some recommendations.

5. 1 Conclusion

- Farmers were found interested to cultivate local seed varieties in comparison with hybrid one due to several reasons like better taste, longer storage capacity, availability of seed, disease- and weather stress-toleance, etc.
- The resource, tool and techniques used in demonstration plots were found locally sound, sustainable and cost-effective and thereby eco-friendly
- The yield of indigenous varieties was found better with proper irrigation and application of compost manure, green manure, Jholmol, and bio-pesticides
- Good market price for indigenous varieties was found and

which creates great income generating opportunities for rural and small farmers

- Farmers have their own techniques and tools for farming of available indigenous varieties
- Farmers have good practice of record keeping of their investment and income

5. 2 Recommendations

- There is a need for certification of indigenous, eco-friendly farming practices by the government
- There is a need for linkage of rural and marginalized farmers with the government officials for financial, technical and other supports
- Market availability should be ensured by the government for selling the products of farmers on a sustainable basis
- There is a need for scaling up of the farming techniques through capacity building and constant field visits for monitoring and mentoring to the farmers
- Government's ownership and linkage are the milestone for conservation, and promotion in a sustainable way

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