Government of Nepal
Ministry of Forests and Environment

BARRIER ANALYSIS AND TECHNOLOGY ACTION PLAN FOR MITIGATION TECHNOLOGIES

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Barrier Analysis and Technology Action Plan for Mitigation Technologies

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FOREWORD

Nepal is one of the most vulnerable countries to climate change, with increased events of flash floods, glacial lake outbursts floods, droughts, landslides, heat and cold waves, and extreme variability in rainfall in recent years. An increase in these climate events has already threatened the country's development efforts and the lives and livelihoods, particularly of women and marginalized groups.

Given the country's vulnerability to the effects of climate change, Nepal has made climate change a top priority. Nepal is a signatory to the United Nations Framework Convention on Climate Change, has ratified the Kyoto Protocol and the Paris Agreement, and has recently submitted its second Nationally Determined Contribution (NDC). Despite its negligible contribution to global greenhouse gas emissions, the second NDC notably plans to achieve carbon neutrality by 2050. International climate finance is critical to meeting NDC targets, but Nepal also needs assistance with capacity building and the dissemination of climate smart technologies.

The problem of a lack of technological innovation and development is widespread in the developing world, and Nepal is no exception. Furthermore, there are a number of impediments to the widespread adoption of technologies in the country. This report is the result of a multi-stakeholder process conducted as part of the TNA project, which identified barriers to the prioritized technologies, measures to overcome those barriers, and a technology action plan for the potential sectors. It is hoped that this report will serve as a valuable reference document for all levels of government and development actors as they implement prioritized technologies to address climate change.

Although this is the first TNA report Nepal is submitting, the government would like to work in this area more intensively as the country needs climate-smart technologies that will help Nepal to move in the green, resilient, and inclusive development pathway. It is hoped that this report will not only provoke debate around challenges facing the transfer of technology in various sectors of the economy but also pave the path for future interventions.

I would like to thank all the colleagues, experts, and stakeholders who were involved in TNA and contributed to this report.

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Nepal is one of the most vulnerable countries to climate change, while also aspiring to contribute to the Paris Agreement's low-carbon development imperatives. Because Nepal intends to become a middle-income country by 2030, its development goals must align with a low-carbon, climate-resilient path.

I am confident that the Barrier Analysis and Technology Action Plan for Mitigation Technologies commissioned by the Ministry of Forests and Environment (MoFE), Government of Nepal, with assistance from the Global Environment Facility and the United Nations Environment Programme, will provide an opportunity for Nepal's low carbon climate-resilient development by identifying and understanding the barriers.

This report was prepared through a rigorous consultative and expert-led process that included relevant stakeholders. It provides a clear process for the transfer and diffusion of prioritized mitigation technologies, identifies barriers, and creates an enabling environment for overcoming potential barriers that may arise while implementing climate change-related technologies and measures at the national and sub-national levels. I am confident that implementing the technology action plan for the mitigation technologies suggested by the assessment report will aid in identifying and developing technologies that reduce greenhouse gas emissions while also accruing adaptation co-benefits. Furthermore, I believe that this report will provide a solid foundation for the country's ambition of achieving net-zero emissions by 2050. I am hopeful that national and international development partners will step in to help promote these prioritized technologies as part of the Nepalese government's efforts to ensure a low-carbon, climate-resilient society. I am also hopeful that this report will accelerate climate action at all three levels of government: local, provincial, and federal.

On behalf of the Ministry of Forests and Environment, I would like to thank the TNA team who have carried out this assessment. I thankfully acknowledge the support provided by Climate Change Management Division Colleagues Dr. Arun Prakash Bhatta, Mr. Raju Sapkota, Ms. Srijana Shrestha, Ms. Shreejana Bhusal, Ms. Muna Neupane, Mr. Yam Prasad Pokharel, Mr. Ram Prasad Awasthi, Mr. Narayan Raymajhi, Mr. Som Nath Goutam and Mr. Hari Krishna Laudari for their valuable work to finalize this TNA Assessment Report. Furthermore, I would like to thank all the team members, external experts, and consultants who have provided support in the TNA process.

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ABBREVIATIONS

AFU	Agriculture and Forestry University
AWD	Alternate Wetting and Drying
AEPC	Alternative Energy Promotion Centre
BRT	Bus Rapid Transit
BSP	Biogas Support Programme
CDM	Clean Development Mechanism
DADO	District Agriculture Development Office
DFRS	Department of Forest Research and Survey
DLSO	District Livestock Services Office
FAO	Food and Agriculture Organization
FY	Fiscal Year
GDP	Gross Domestic Product
GHG	Greenhouse Gas
LPA	Logical Problem Analysis
LPG	Liquefied Petroleum Gas
MoALD	Ministry of Agriculture and Livestock Development
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoF	Ministry of Finance
MoFE	Ministry of Forests and Environment
NARC	Nepal Agriculture Research Council
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NGO	Non-government Organization
R&D	Research and Development
REDD	Reduced Emission from Deforestation and Forest Degradation
SRF	Short Rotation Forestry
TAP	Technology Action Plan
UMMB	Urea Molasses Mineral Block
UNEP	United Nations Environment Programme
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat

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Executive Summary

The Technology Needs Assessment (TNA) for Climate Change mitigation technologies in Nepal has identified three major sectors; Agriculture, Energy and Forestry. Through consultative process, stakeholders agreed to focus on these three sectors and further decided to consider the following sub-sectors:

Energy – Transport, and Residential

Agriculture– Livestock, and Rice Cultivation

Forestry– Forest Protection, Management Enhancement of Forest Carbon Stock

Following technologies were prioritized and considered for barrier analysis:

Energy – Bus Rapid Transit (BRT), Biogas, and Electric Cook Stove

Agriculture– Urea Molasses Multi-Nutrient Block (UMMB), and Alternate Wetting and Drying (AWD) of Rice fields

Forestry – Silviculture, and Short Rotation Forestry (SRF)

The barriers were categorized into following two broad groups, namely economic/financial and non-financial. Policy and regulatory issues, social aspects, environmental aspects, market support and networking and technical aspects were considered under non-financial barriers. After identifying the long list of barriers, few major barriers were further analyzed and the measures were proposed. The outcome of this exercise was deliberated among the experts of the sector and a report was prepared. The deliberation also suggested measures to remove the barriers identified for the individual technologies. Every barrier was discussed amongst the experts and measures were identified.

Barriers	Measures
Agriculture Sector: Urea Molasses Mineral Block (UMMB) Technology	
- Gap in national policies establishing focus on GHG mitigation in livestock sector and strengthening existing agricultural commercialization policy - High capital investment - Lack of dedicated subsidy provision for the technology to cover underlying financial risks. - Information and communication gap	- Commercialization of agriculture and livestock sector from subsistence agriculture based on local resources to make it more competitive and climate resilient - Introduce finance and incentive mechanism including subsidies and dedicated credit lines. - Development of an information system for strong network - Shift from forage based livestock development to stall-fed (UMMB) livestock management
Agriculture Sector: Alternate Wetting and Drying (AWD) Technology	
- Financial gap to cover the upfront financing needs for technology implementation.	- Introduction of farmer friendly technologies - Provision of soft loans or subsidies to reduce upfront financing needs - Development of an information system for strong network

Barriers	Measures
- Affordability of the farmers and insufficient knowledge about the technology - Information and communication gap - Need of specific policy measures for adoption, development and improvement of technology. Need of financial instruments including credits and subsidies to enhance bankability of the technology at the farmers' end	- Establish local consumer group to promote water management systems and practices and engage them in policy formulation process. - Enhance financial capability of the community organization through measures targeted toward better crop yield, storage facilities and marketing instruments.
Energy Sector: Bus Rapid Transit (BRT)	
- Policy gap in existing transport and urban policies to specifically address BRT technology. - High investment costs for the infrastructure and long gestation period that inhibit investment confidence. High import tax and excise duty. - Need of coordinated efforts among several agencies from the federal to local levels is likely to make the decision making process more bureaucratic. - Weak infrastructure for BRTs	- Emphasis on efficient mass transportation by government for less emission from road transportation. - Formation of separate policy with better policy measure to leverage private sector investment to build investor confidence attract investments. - Policy reform to reduce excise duty and taxes to encourage implementation of BRT. - Establish a separate institution with authority to deal with several institutions involved in the technology implementation. - Development of infrastructures like dedicated lanes and flyovers for BRTs.
Energy Sector: Biogas Technology	
- High initial installation cost of biogas plant - Need of mechanism to re-channel the carbon revenue generated from operating biogas units to ensure sustainable operation of those units. - Need to strengthen existing maintenance services.	- Focus on R&D for the identification of new prototype of the biogas (other than GGC 2047 model) that might be prepared at lower cost. - Introduction of soft loan schemes and micro-credits for the households - Promote better animal husbandry practices for better yield of raw materials - Provide skill development training and awareness program.
Energy Sector: Electric Cook Stove Technology	
- Extra costs to upgrade to higher current supply and additional costs towards cooking utensils with induction base. - Need of policies to discourage LPG use and encourage use of electric cook stoves.	- Enhance generation of electric power through development of additional hydropower projects. - Differential electricity cost reduce burden at peak load - Development of service and distribution centers in semi urban areas for optimum use of the technology.
Forestry Sector: Silviculture Technology	
- Inadequate resource allocation - More focus of the national policies on maintaining forest stands.	- Access and utilize financial resources generated from international mechanisms such as CDM and REDD.

Barriers	Measures
- Need to develop better know-how of the technology among the experts and institutions. Need of effective multi-stakeholder participation mechanism.	- Introduce policies to enhance forest yield and carbon sink - Capacitate institutions at all levels to keep abreast with the recent development in technology implementation and enhance knowledge of the human resource involved. - Establish local markets to support forest based enterprises.
Forestry Sector: Short Rotation Forestry (SRF) Technology	
- Inadequate investment in research and demonstration. - Missing linkages in the existing policies and plans to enhance and conserve forest carbon stock. - Inadequate data available on baseline situation of forest biomass - Inadequate information regarding market system	- Promote investments from government, non-government and private sectors as well as international funds - Adopt specific strategies addressing the issues related to SRF for enhancement and conservation of forest carbon stocks. - Conduct specific capacity building activities to increase technical capacity of relevant experts and governments in SRF technology. - Perform market feasibility survey and establish local markets to support forest entrepreneurship

CHAPTER-1: AGRICULTURE SECTOR

1.1 Overview

Contribution of agriculture sector to Gross Domestic Product (GDP) has been decreasing whereas that of non-agriculture sector has been increasing over the last decade. In the Fiscal Year (FY) 2010/11, the contribution of agriculture sector to GDP was 37.1 percent which fell to 27.7 percent (combined with forest and fisheries) in the FY 2019/20. The contribution of agriculture and non-agriculture sector to GDP were 27.5 percent and 72.5 percent respectively in the fiscal year 2018/19 (MoF, 2020). Compared to that of the last fiscal year, the structure of agriculture and non-agriculture sector is slightly changed this year. The involvement of population in the agricultural sector is gradually declining due to the increasing use of technology and professionalism in agriculture and expansion of service sectors. According to the Nepal Labor Force Survey of 2008, 73.9 percent of the population was engaged in agriculture sector, but in 2018 the proportion has decreased to 60.4 percent (MoF, 2020). As stated, use of available modern technologies is one of the reasons for declining population active in agriculture sector. Better mechanization of the agriculture sector and improvement in cropping and livestock raising practices still provides room for low carbon agricultural practices.

The key documents of the government for the country's agricultural development including concerns related to climate change include:

- The Fifteenth Plan (2019/20-2023/24)
- National Adaptation Program of Action (NAPA), 2010
- Agri Business Promotion Policy, 2006
- National Agriculture Policy, 2004
- Dairy Policy, 2007
- Agriculture Development Strategy, 2012
- Agriculture Mechanization Promotion Policy, 2014
- National Climate Change Policy, 2019
- Second Nationally Determined Contributions (NDC), 2020

Under agriculture and food security sector, the National Climate Change Policy (NCCP), 2019 adopts measures to promote water efficient technologies and low carbon emission and energy efficient technologies for production, collection, processing and storage. Similarly, the second NDC aims, among others, to promote intercropping, agroforestry, conservation tillage, and livestock and agricultural waste management and to increase the improved cattle sheds to 500,000 for quality farmyard manure production and use.

1.2 Livestock Management Urea Molasses Mineral Block Technology

1.2.1 Introduction of the UMMB technology

Urea Molasses Mineral Block (UMMB) is a special preparation (15 part urea, 28 part molasses, 40 part bran, 1 part salt and 4 part lime) made into blocks of up to two kilogram weight. This type of block, upon feeding, has been proven to increase the milk production by utilization of non-protein nitrogen (NPN) for protein synthesis in rumen of poly gastric ruminant animal and thereby reduce methane production and emission. This is a cost-effective feeding strategy and is being used by the farmers in comparatively commercial area and districts like Chitwan, Nawalparasi, Morang, Sunsari, Rupandehi Makawanpur districts. National Agriculture Research Council (NARC) has developed the equipment to produce UMMB and is being distributed to commercial farmers and groups through district Livestock offices and NARC stations. This may bring about economic and social co-benefits, particularly for the rural poor (Uprety, 2007). Few commercial productions of UMB and UMMB have just started. Main barriers are identified in terms of the availability of the raw materials in rural and remote areas, time-consuming preparation process, and inadequate extension of this technology with required modifications in terms of ingredients suiting specific location.

1.2.2 Barrier Identification for UMMB Technology

The team of experts involved in Technology Needs Assessment carried out the participatory approach in identifying the barriers with the deployment and diffusion of the technology. Pertinent national policies and reports were reviewed in an endeavor to identify gaps for the widespread application of the technology. This was further carried out with the roster of experts involved in the research institutions on the possible policy and institutional barriers that inhibit the acceleration of research and development, and application of this technology.

The long list of barriers was compiled under five headings; namely, the policy, institutional, economic, environmental and technical. Later they were grouped into two specific barriers viz. economic and financial barriers, and non-economic barriers.

a. Economic and Financial Barriers

The greatest challenge for the technology in its implementation has been identified as the need for capital investment in research and demonstration. Available financial resources to promote research and development for the UMMB technology was assessed to be inadequate. Similarly, the purchase and transportation cost of block ingredients and equipment to prepare blocks are likely to increase the product cost at farmers' end. Moreover, initial phase of the production is expected to face higher costs towards the skilled and trained human resource including the technicians. By far, the UMMB technology is not covered under any subsidy scheme by the Government of Nepal and the cooperatives are also reluctant to opt the technology widely as it is yet to be extended in scale to build market confidence for adoption.

b. Technical Barriers

The key technical barrier identified is in terms of the availability of trained human resources required to develop and expand the technology, among others, through delivery of the required extension services to farmers. Although the technology is proven elsewhere, it might face challenges due to limited availability of raw ingredients locally. While this can be tackled through the research and development on customizing the ingredients as per local conditions, the investment on research and development becomes inevitable and this demands for additional resources to be put in place.

c. Policy Barriers

Reduction in GHG emission from the livestock sector has not been the central focus of national policies by far. However, with the national policies related to the agriculture and livestock (Agriculture Mechanization Policy for example) acknowledges the fact that the commercial livestock raising is gaining momentum in Nepal in recent years. Since there was practice for livestock rearing to meet domestic needs of milk and draft power, livestock rearing was not an organized sector and policy on reducing GHG from the livestock sector was not the priority focus. However, with the conducive policy measures encouraging livestock development and promotion included in the National Agriculture Policy, 2004, Agri Business Promotion Policy, 2006 and Agriculture Mechanization Policy, 2014, livestock sector is gaining momentum and gradually evolving as a commercial venture throughout the country. In this context, a need is felt to introduce policy measure through revision of existing policy document or introduction of new set of policies to systematically reduce GHG emission from the livestock sector.

d. Institutional Barriers

Institutional barriers were assessed with regards to the operation of various sectoral institutions in silo. While the institutional arrangement was in place with defined role and responsibility of each institution from the national, subnational and local government and related institutions with specific institutional hierarchy, inter institutional coordination mechanism seemed to be lacking in case of specific issue that attracted multiple stakeholders. In case of UMMB technology, the policy guidance, research and development, crop production and production of molasses demand cross-sectoral coordination among the diverse range of stakeholders such as Ministry/Department, R&D institutions, farmers and sugar industries. A specific coordination mechanism, since is expected for specific issue as in case of the UMMB technology, an institutional coordination system of a permanent nature may not be required at all time; however, a case specific task force to deal with that specific issue is desirable. In the recent context of federalization where there are three levels of government, how the devolution of power from federal to the provincial and local institutions translate in addressing the policy, R&D and production related issues is still uncertain. Moreover, how the new institutional arrangement bridges communication and information at all levels of institution and the farmers need to be figured out.

e. Environmental Barriers

There are no environmental barriers as such for the dissemination of this technology. However, caution should be taken while mixing chemicals (urea and lime) ensuring appropriate and effective doses to be administered to the livestock.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in establishment (formulation and implementation) of UMMB technology in livestock farming is presented in Figure 1.

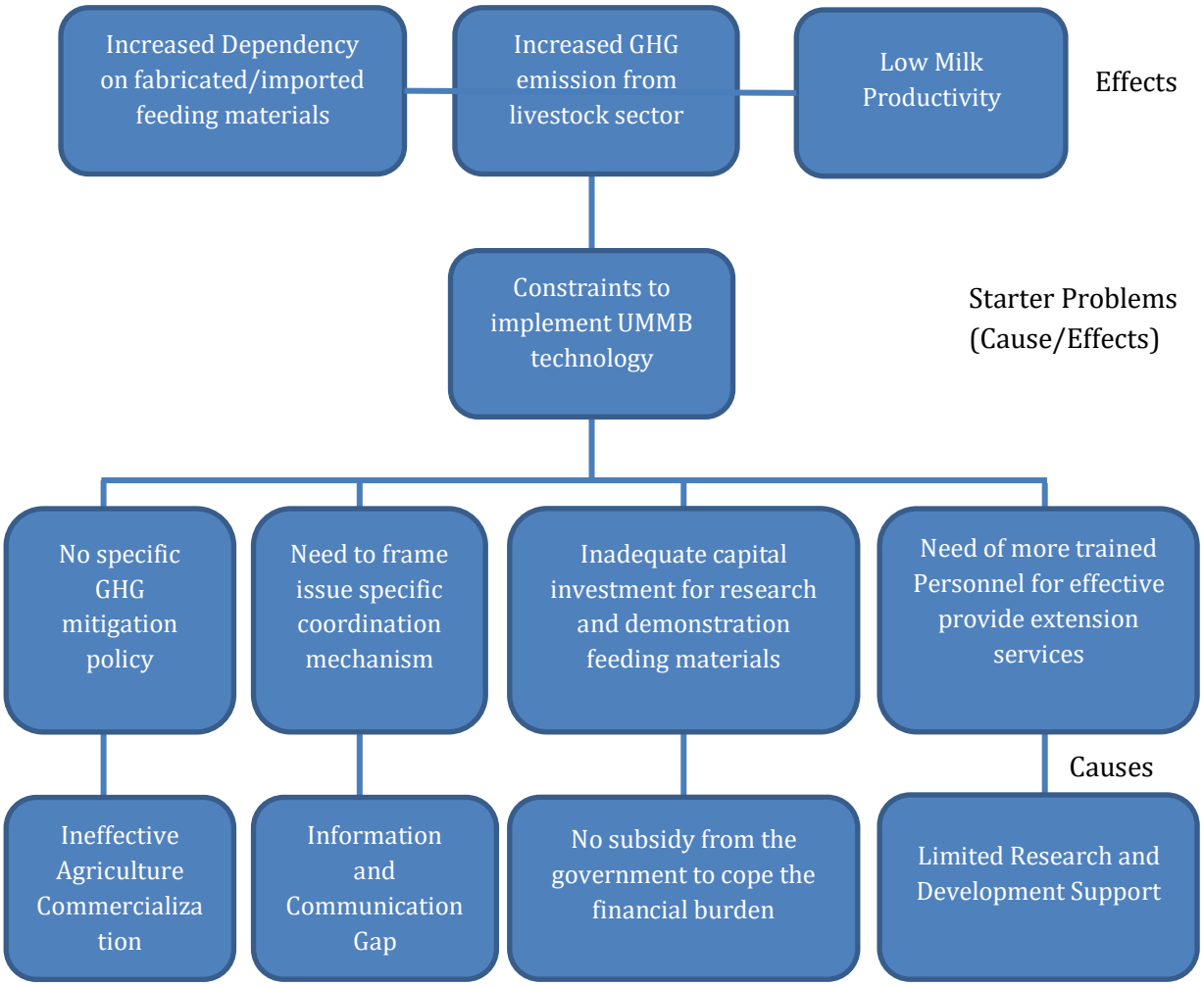

Figure 1: LPA for financial/non-financial barriers in implementing UMMB Technology

1.2.3 Measures to overcome Barriers for UMMB Technology

Identifying measures is simply a process that enables or motivates a particular course of action or behavioral change with the objective of overcoming barriers for the implementation of the technology. The measures considered should sustain all the levels of involvement viz. innovation, R&D, deployment and diffusion.

Policy measures of in-country and out-country were considered as an important input to the process. Technology Transfer Perspective Series developed by UNEP RISO Centre was utilized as the guidebook to prepare enabling frameworks for the technology. This also involved the same procedure as of identification of barriers and the measures were mainly grouped under two

headings. The measures were devised such that it presents the way forward from problems to solutions.

a. Economic and Financial Measures

The following measures are proposed with an objective to overcome the economic and financial barriers of the technology:

- Expedite commercialization of agriculture and livestock sector from subsistence agriculture based on local resources to make it more competitive and resilient vis-à-vis climate change
- Develop financing mechanisms and incentives to promote the development and use of UMMB.

b. Non-financial Measures

Creation of Network

- Develop an information system to establish networking among stakeholders to exchange problems, ideas and solutions.
- Upgrade livestock offices at provincial and local levels with additional skilled human resource to train farmers in their respective areas of jurisdiction
- Publication and distribution of leaflets, tool book, training manuals, etc.
- Support the local community based organizations (agricultural cooperatives and milk production cooperatives) with information about the technology.

Policy Measures

- Formulate defined strategies related to GHG mitigation specific to livestock sector
- Develop clear directives regarding the duties and responsibilities of different stakeholders
- Perform research and demonstration activities to build the technology confidence among farmers to enhance the technology penetration among farmers compared to the business-as-usual scenario.

Skills, Training and Education

- Provide training to researchers and farmers with the knowledge/methods for the preparation of block and to improve its quality with the use of local materials as ingredients. Farmers to farmers training program in villages should be promoted.
- Arrange exposure visits for wider adoption of approved technology
- Conduct periodic demonstration programs to enhance skills, capacity and knowledge of the farmers to enhance the adoption rate.
- Conduct specific capacity building activities to increase capacity of technical experts engaged at various levels of institutions.
- Conduct awareness campaigns to raise benefits of local feed materials and ingredients for UMMB, and their value addition

Market Support System

- Prepare UMMB machine at local level and make the technology user-friendly
- Develop local market for the UMMB as well as milk product

- Discourage the import of fabricated feeding materials from outside
- Make the ingredients and methods easily available and affordable

The LPA for the measures to overcome the barriers in implementing UMMB technology is presented in Figure 2.

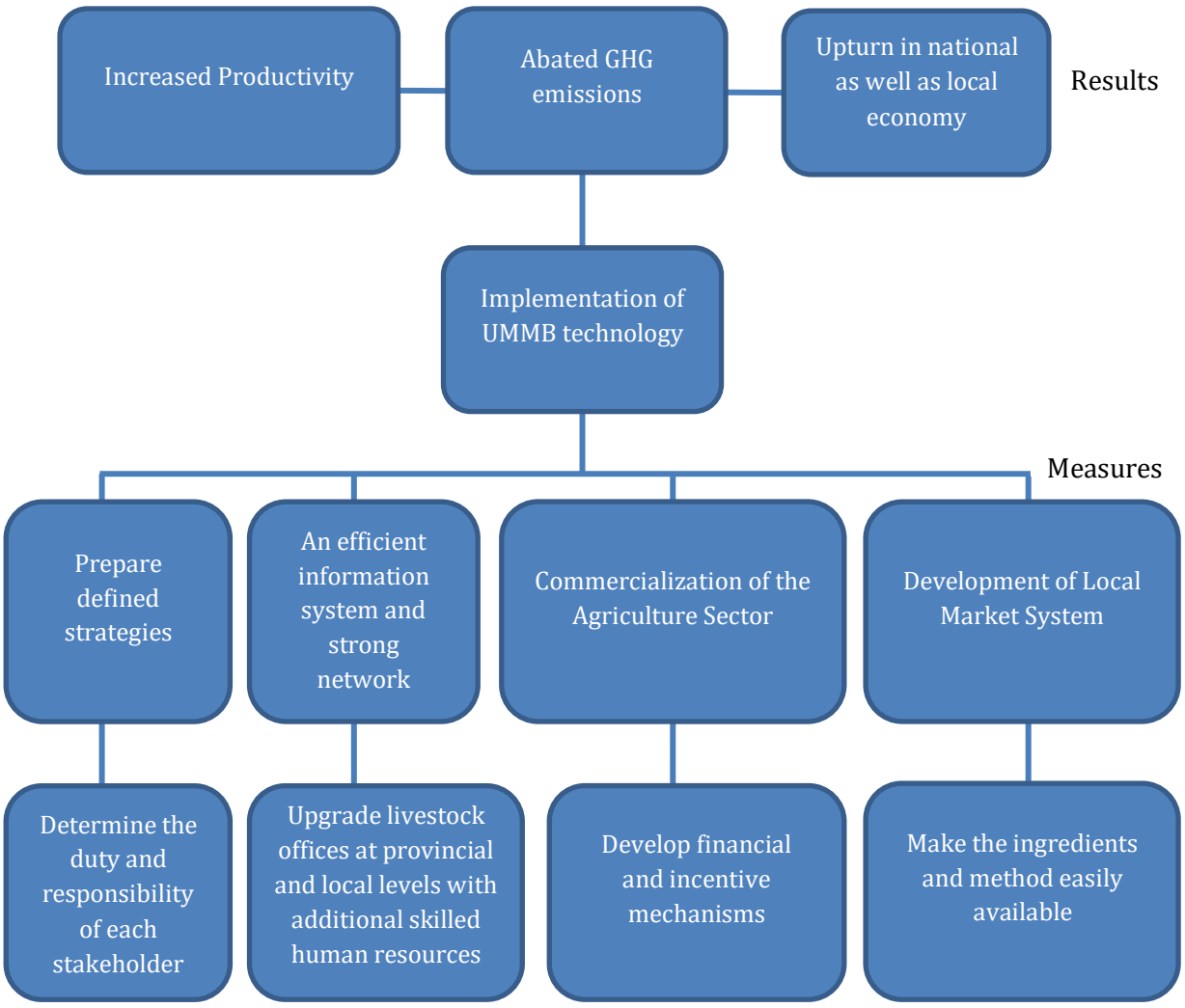

Figure 2: LPA for financial/non-financial measures in implementing UMMB Technology

1.2.4 Technology Action Plan for UMMB Technology

Based on the assessment of the technological needs, barriers and measures, Technology Action Plan (TAP) has been prepared for the UMMB technology which is presented in Table 1.

Table 1: TAP for introduction of livestock management (UMMB) technology

SN	Measures	Priority	Why it is important?	Time Scale	Related Stakeholders& Implementers	Key indicators	Risks	Funding Sources	Costs
Economical/Financial									
1	Develop mechanism for long-term and low-interest loans, as well as grants through public and private funds	High	Makes farmers financially secured	0-5 years	MoALD, DLSO, Banks, farmers, Communities, etc.	Easy access of farmers to financial means	Inability of farmers to pay back loans at times of natural disasters	Local and national financial organizations and VDC budget	US$ 50,000
Policy/Regulatory									
2	Develop specific mechanism to popularize the technology	High	Makes farmers willing to invest in technology	0-10 years	MoALD, National Planning commission, etc.	Technological package available & farmers adopting it	National system is under capacity to provide the technology	National and local such as cooperatives and agencies	US$ 100,000
Technological									
3	Technical support to R&D institutions Easy access to the blocking machine and skill	Medium	Strengthens institutional capacity	0-10 years	NARC, MoALD, IAAS, AFU, etc.	Technology developed and delivered	Slow process of technology development & topographical heterogeneity	National and local agencies, industries, cooperatives, etc.	US$ 2000,000
4	Strengthen international research network	Medium	Strengthens institutional R&D capacity	0-10 years	NARC & IAAS	Newer technologies in framers' field	Loss of indigenous technology and knowledge, animal biodiversity	International Organizations	US$ 500,000
Institutional Capacity									
5	Organize specific capacity building programs (trainings, seminars, workshops) for local farmers	High	Exposure of concerned individuals to the technology and exchange of ideas	0-5 years	NARC, MoALD, IAAS, AFU, concerned famers, etc.	Researchers, extension workers and farmers are well familiar with the technology	Needy people may not get the opportunity & there may not be sufficient fund for the events	National government organizations, I/NGOs, cooperatives	US$ 5000,000
6	Develop and conduct information	High	Make general farmers aware	0-5 years	GO, NGO, cooperatives,	Farmers are well aware of	The campaign may not reach to remote areas	National and Local , local GO, NGO, etc.	US100,000

SN	Measures	Priority	Why it is important?	Time Scale	Related Stakeholders& Implementers	Key indicators	Risks	Funding Sources	Costs
	campaigns on the advantages of applied technology		of the technology and kin to it		educational institutions, radio, TVs	the advantage of the technology and have adopted	and continuity may also be problem.		
7	Develop mechanism for support to agriculture/livestock extension services	High	Strengthening DLSO, LSC & other extension institutions	0-5 years	Research teaching & extension institutions	Efficient and smart extension service delivered	Lack of fund and inaccessibility	National and local public as well as privet agencies	US100,000
Others									
8	Development Partner coordination in order to enhance support to R&D project initiatives related to the technology	High	Build the capacity of national agricultural institutions	0-10 years	International agricultural research and development institutions and Development Partners	National agricultural research and development institutions getting continuous support and technology being refined	Misuse of the fund and not reaching to the targeted institute/agency/community	International agricultural research and development institutions and Development Partners	US 100,000
9	Develop mechanism for implementation of demonstrative farms projects	High	Make the farmers believe and make them confirmed about the benefits of the technology	0-5 years	National agricultural research, teaching extension and development institutions along with the local communities	Confidence about the technology among the farmers developed	Demonstration of incomplete technology and inaccessibility of common farmers to the demonstration site	National agricultural fund through DLSO and other agencies, NGOs, etc.	US 500,000

1.3 Alternate Wetting and Drying (AWD) Technology

1.3.1 Technology brief

Water management is one of the most confounding factors affecting methane emission. The average methane emission in saturated soil was found to be 0.3 to 0.6 kg/ha/day while it was only 0.1 to 0.4 kg/ha/day in intermittent wetting and drying. Intermittent irrigation is an option for minimizing methane emission. Increasing water percolation would add oxygen-rich water to the reduced soil layer and decrease methane production (Vivekanandan and Jayasankar, 2008).

The application of AWD technology aims to reduce the adverse impact of climate change on rice productivity due to water stress and mitigate climate change through the reduction of methane emission. Water management is one of the most confounding factors affecting methane emission. The technology of similar type is being used by the farmers in hills where rice fields are fed by small rivulets. The general practice in our rice farming is the cultivation of crop under continuous flooding till he water is available which is responsible for methane emission. In contrast to the traditional practice of continuous flooding, the AWD technology contributes to increase the water use efficiency hence increases the crop yield. This will in turn contribute to total national food production to meet the growing food demand. There exist some constrains, however, like reduction in rice productivity while using this technology if moisture stress condition is beyond the control. In this situation water harvesting during rainy season and using it when necessary may be the pre-condition. This is a new technology to rice growing communities of Nepal and there is a need of orientation training and exposure visits for the farmers and the extension workers to get insight of this technology. Similarly, interaction between technicians and farmers for the systematic transfer of this technology is imperative. Not only this, but the technology also demands construction of water storage, irrigation and drainage structures.

1.3.2 Barrier Identification for AWD Technology

The team of experts involved in Technology Needs Assessment carried out participatory approach in identifying the barriers with the deployment and diffusion of the technology. Various national policies and pertinent reports were reviewed in an endeavor to identify gaps behind application of the technology. This was further carried out with the roster of experts involved in the research institutions on the possible policy and institutional barriers that inhibit the acceleration of research and development of the technology. The barriers identified for the AWD technology is summarized below:

a. Economic and Financial Barriers

The technology may require, depending on the condition, some construction works (building of irrigation and drainage systems) to store and control the water and skilled human resource to manage the system. Further, implementation of technology will require financial assistance to cover the upfront financing needs in form of subsidies or dedicated credit lines are required for construction of infrastructures.

b. Technological

This technology requires additional skills for regulating water in the rice fields, contrary to what farmers are doing traditionally i.e. flooding the rice field throughout the growing season or as per the water availability. The seasonal mono-modal rainfall pattern in Nepal may make this system difficult to maintain and require technological arrangement for that.

c. Policy Barriers

Nepal has an irrigation policy in place that highlights the policy measures to increase irrigated area, irrigation efficiency, and thereby increase crop yield in irrigated area and its systematic operation and maintenance. The existing policy attempts to establish linkage among farmers, cooperatives and private sectors to foster agricultural development and ease in the implementation of these policies. However, emphasis on construction of big irrigation projects, which may not always be practical option for small holder farmers and to all farmers throughout the country is considered as policy constrain for the implementation of this technology.

d. Institutional Barriers

Effectiveness of the technology in enhancing paddy yield in general and specific pockets for the farmers to adopt this particular type of technology are still required to be explored. The same technology may not generally fit into all local condition and it is desirable that technology is recommended for use at specific locations for better results. This demands for focused research and development targeting specific areas. In the context where agricultural offices at provincial and local levels have limited scope for research and development, institutional collaboration with the research institutions and universities is desirable.

e. Environmental Barriers

The main environmental problem is the imposed alteration of soil-water regime of the landscape with an imposition of forced wetting and drying conditions while managing the water courses. Apart from this, soil erosion may occur due to drying of certain sites.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in establishment of AWD technology is presented in Figure 3.

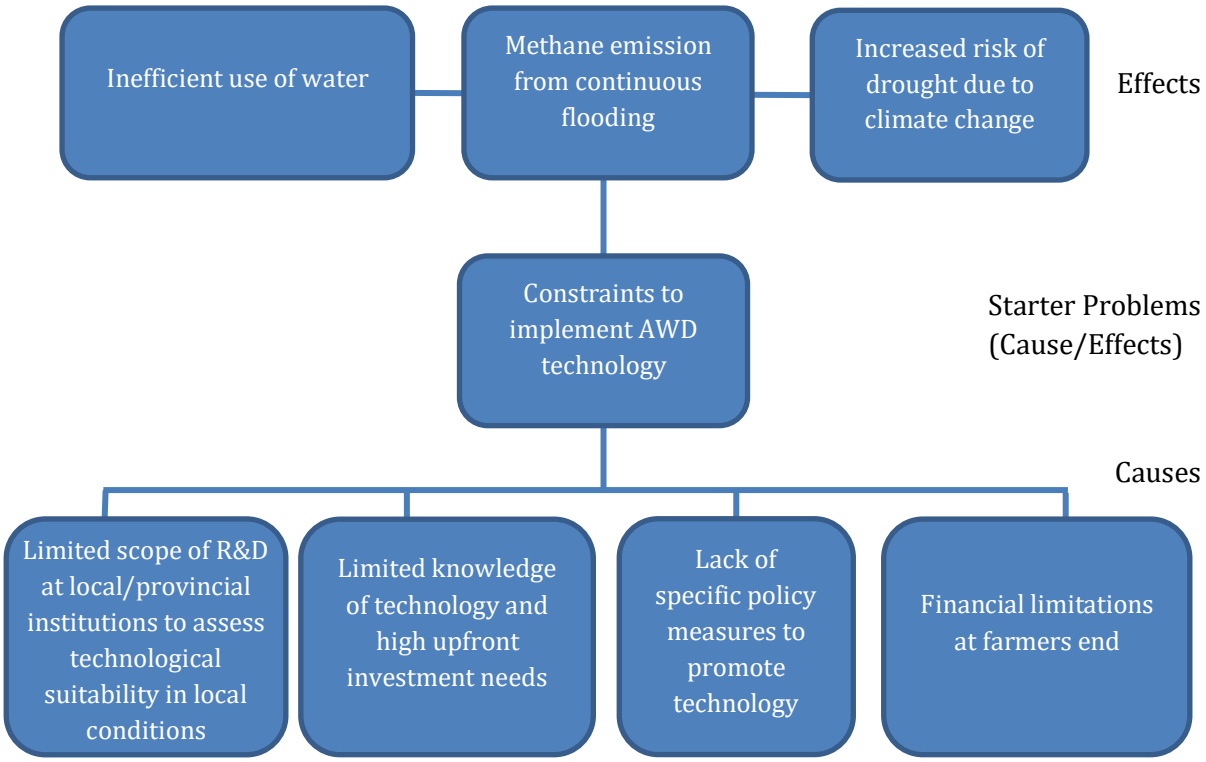

Figure 3: LPA for financial/non-financial barriers in implementing AWD Technology

1.3.3 Measures to overcome Barriers for AWD Technology

Identifying measures is simply the process that enables or motivates a particular course of action or behavioral change with the objective of overcoming barrier towards implementation of the technology. The measures considered should sustain all levels of involvement viz. innovation R&D, deployment and diffusion.

Policy measures of in-country and out-country were considered as an important input to the process. Technology Transfer Perspective Series developed by UNEP RISO Centre was utilized as the guidebook to prepare enabling frameworks for the technology. The procedure of barrier identification and the measures were mainly grouped under two headings; the financial and non-financial.

a. Economic and Financial Measures

The following measures are proposed with an objective to overcome the economic and financial barriers of the technology.

- Making the construction of water storage, and irrigation and drainage structures affordable to farmers through incentives and subsidies
- Provision of subsidies or soft loans through banks as per the need of farmers
- Enhancing financial capability of the village level community organizations through injection of measures targeted towards enhancing crop yields, storage facilities and marketing instruments.

b. Non-financial Measures

Creation of Network

- Create network of cooperatives and community based organizations to conduct training programs in villages
- Publication of leaflets, training manuals, etc.
- Establish linkage between farmers, water user groups and local extension system
- Community construction works in taming the water sources

Policy Measures

- Effective watershed management program.
- Establish water consumers' group to promote local water management systems and practices.
- Promote bottom-up approach with involvement of local farmers in policy formulation process

Skills, Training and Education

- Raise awareness of the benefits of alternate wetting and drying in rice cultivation
- Train manpower to disseminate the technology
- Train the people to conserve local water resources
- Educate farmers about an efficient weed management method in AWD

Market Support System

- Develop local market for the products
- Promote local agro-industries (rice based cottage industry).
- Make the quality construction materials and equipment available in time as per need

The LPA for the measures to overcome the barriers in implementing AWD technology is presented in Figure 4.

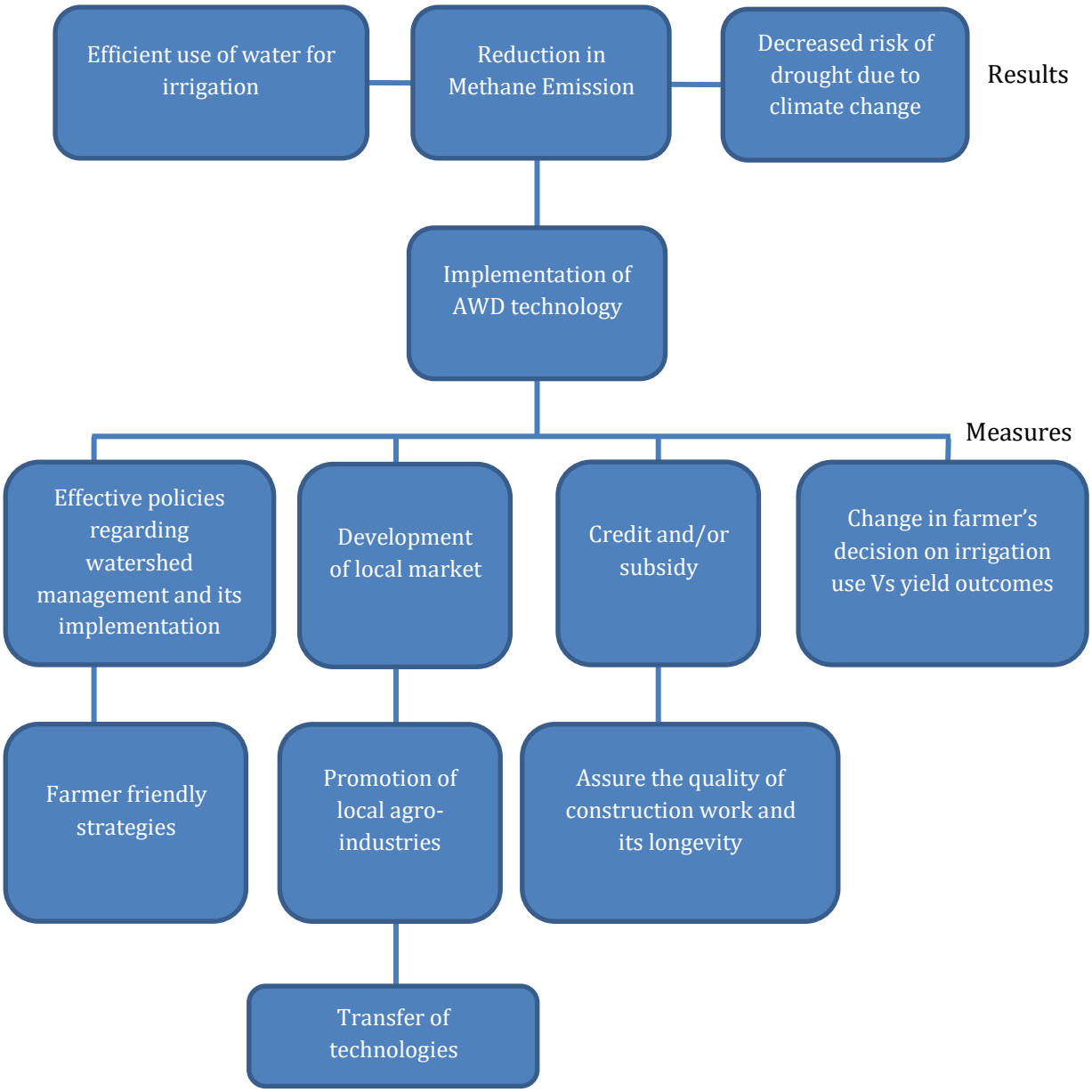

Figure 4: LPA for financial/non-financial measures in implementing AWD Technology

1.3.4 Technology Action Plan for AWD Technology

Based on the assessment of the technological needs, barriers and measures, technology action plan has been prepared for the AWD technology. TAP for the AWD technology is presented in Table 2.

Table 2: TAP for introduction of Alternate Wetting and Drying Technology

SN	Measures	Priority	Why it is important?	Time Scale	Related Stakeholders & Implementers	Key indicators	Risks	Funding Sources	Costs
Economical/Financial									
1	Develop mechanism for soft loans, as well as grants through local and national public, private organizations	High	Makes farmers financially secured	0-5 years	MoALD, Banks, farmers , NGOs, cooperatives, Communities, etc.	Easy access of farmers to financial means	-High interest of banks, -Inability of farmers to pay back -Lack of funds	National and international financial organizations	US$ 500,000
Policy/Regulatory									
2	Develop specific policy mechanism to popularize the technology	High	Makes farmers/cooperatives willing to invest in technology	0-10 years	MoALD, National Planning commission, etc.	Technological package developed available & farmers adopting it	National system is under capacity to provide the technology through the rice growing areas	National and International agencies	US$ 300,000
Technological									
3	Technical support to R&D institutions Easy access to irrigation, drainage & weed management means and skills	Medium	Strengthens institutional capacity	0-10 years	NARC, MoALD, IAAS, AFU, etc.	Technology developed and delivered	Slow process of technology development & topographical heterogeneity	National and local public and privet organizations	US$ 1000,000
4	Strengthen national and international research and extension network	Medium	Strengthens institutional R&D capacity	0-10 years	National/International Agriculture Research System	Technology with new insights will be in framers' field	Environmental alternation due to taming the water courses	National and international Organizations	US$ 500,000
Institutional Capacity									
5	Organize specific capacity building programs (trainings, seminars, workshops) for local farmers	High	Exposure of concerned individuals to the technology and exchange of ideas	0-5 years	NARC, MoALD, IAAS, AFU, concerned famers, etc.	Researchers, extension workers and farmers are well familiar with the technology	Farmers may be reluctant towards the technology due to weed problems and mindset about the rice crop	National governmental organizations, I/NGOs, cooperatives	US$ 500,000

SN	Measures	Priority	Why it is important?	Time Scale	Related Stakeholders & Implementers	Key indicators	Risks	Funding Sources	Costs
6	Develop and conduct information campaigns on the advantages of applied technology	High	Make general farmers aware of the technology and kin to it	0-5 years	GO, NGO, cooperatives, educational institutions, radio, TVs	Farmers are well aware of the advantage of the technology and have adopted	The campaign may not reach to remote areas and maintenance of the system especially in in high rainfall areas may be the problem and costly as well	National and Local , local GO, NGO, etc.	US100,000
7	Develop mechanism supportive to agricultural extension services	High	Strengthening DADO and extension institutions	0-5 years	Research teaching & extension institutions service	Efficient and smart extension service delivered	Lack of fund and inaccessibility	National and international agencies	US300,000
Others									
8	Development Partner coordination in order to enhance support to R&D project initiatives related to the technology	High	Build the capacity of national and local agricultural institutions	0-10 years	International agricultural research and development institutions and Development Partners	National agricultural research and development institutions getting continuous support and technology being refined	Misuse of the fund	International agricultural research and development institutions and Development Partners	US 100,000
9	Develop mechanism for implementation of demonstrative farms projects	High	Make the farmers assured about the technology	0-5 years	National agricultural research, teaching extension and development institutions along with the local communities	Confidence about the technology among the farmers developed	Demonstration of incomplete technology and inaccessibility of common farmers to the demonstration site	National agricultural fund through DADO and other agencies, NGOs, etc.	US 1000,000

1.4 Linkages of the barriers identified in Agriculture Sector

The major barriers identified in the dissemination/diffusion of the proposed two technologies have many aspects in common. The identified barriers common to both the technologies are summarized in the Table 3.

Table 3: Linkages between the barriers in Agriculture Sector

Barrier	Technologies	
	UMMB	**AWD**
Economic/ Financial	- Capital investment for research and demonstration - Lack of dedicated subsidy provision for the technology to cover underlying financial risks. - Limited capacity of farmers to buy raw materials	- Financial gap to cover the upfront financing needs for technology implementation. - Construction of water storage, irrigation and drainage structures which may be beyond the capacity of the farmers
Policy	- Gap in national policies establishing focus on GHG mitigation in livestock sector - Strengthening existing policy related to agricultural commercialization incorporating issues related to climate change	- Need of specific policy measures for adoption, development and improvement of technology.
Technical	- Gap in the need of extension service and availability of trained human resource to offer extension service. - Relatively new technology to be penetrated at scale.	- Farmers are not much familiar with the technology and it needs demonstration and extension services along with research and development efforts
Market support systems	- Easy access to the ingredients in all parts of the country - Information and communication gap	- Effective and user friendly tools for efficient water use and weed management

1.5 Enabling framework for overcoming the barriers in Agriculture Sector

The proposition is to manage the paddy cultivation in an alternate way to what is traditionally being done. Generally, rice is cultivated with flood water which is one of the potent greenhouse gas (methane) emitters. The AWD technology has been proven to be productive, mainly through root aeration that promotes tillering and enhance yield, water use efficient, and reduces methane emission. The technology needs experts to train farmers, and extension system to convince them. It also needs the construction of irrigation and drainage system from micro to macro scales for effective water regulation. Similarly, there is a necessity of knowledge enhancement for more efficient and cheaper means of water management based on scientific studies using local materials. It also needs training for both experts and farmers with regards to the timing and duration of irrigating and draining water from the field. Similarly, the technology needs special attention to manage the weeds. This is possible when there is good networking among the research, extension and training experts at local, provincial or national levels. Further, to make the technology popular among the farmers it needs method and result demonstration sites/activities that make the farmers convinced, which may bring the change in farmers' attitude and behavior. The enabling frameworks for the technologies in agriculture sector are listed in Table 4.

Table 4: Enabling Framework in Agriculture Sector

Barriers	Measures
UMMB	
- Gap in national policies establishing focus on GHG mitigation in livestock sector and strengthening existing agricultural commercialization policy - High capital investment - Lack of dedicated subsidy provision for the technology to cover underlying financial risks. - Information and communication gap	- Commercialization of agriculture and livestock sector from subsistence agriculture based on local resources to make it more competitive and climate resilient Introduce finance and incentive mechanism including subsidies and dedicated credit lines. - Development of an information system for strong network - Shift from forage based livestock development to stall-fed (UMMB) livestock management
AWD	
- Financial gap to cover the upfront financing needs for technology implementation. - Affordability of the farmers and insufficient knowledge about the technology - Information and communication gap - Need of specific policy measures for adoption, development and improvement of technology. Need of financial instruments including credits and subsidies to enhance bankability of the technology at the farmers' end	- Introduction of farmer friendly technologies - Provision of soft loans or subsidies to reduce upfront financing needs - Development of an information system for strong network - Establish local consumer group to promote water management systems and practices and engage them in policy formulation process. - Enhance financial capability of the community organization through measures targeted toward better crop yield, storage facilities and marketing instruments.

CHAPTER-2: ENERGY SECTOR

2.1 Overview

Nepal's energy consumption per capita is one-third of the Asian average and less than one-fifth of the world average. Until recently, Nepal was facing challenges in meeting its energy demands. The per capita energy consumption, as per the World Bank estimate, was 434.45[1] Kg of oil equivalent in 2014 which is one of the lowest in South Asia. The World Bank estimate for the same year reports, that with each Kg of oil equivalent used Nepal is able to produce 5.96 USD which is around 60 percent of South Asian average (9.71 USD) for 2014. The disparity in consumption of energy and production of GDP is an indication for one of the two things; either better economic growth may be achieved with the same level of input energy or the same level of economic growth can be maintained with reduction of input energy. In either case, there is clear scope for efficiency improvement that will result in the reduction of GHG emissions.

Total energy consumption in the year 2008/09 was 9.3 million tonnes of oil equivalent (401 million GJ) in the country out of which 87 percent were derived from traditional resources, 12 percent from commercial sources and less than 1 percent from the alternative sources (WECS, 2010). As the larger fraction of the population fulfils its energy need from the traditional resources, it is imperative to address the technological needs and innovation in traditional energy production and supply system to address overall issues and challenges of energy sector. The key documents of the government for the country's energy development including concerns related to climate change include:

- The Fifteenth Plan (2019/20-2023/24)
- National Climate Change Policy, 2019
- Rural Energy Policy, 2006
- National Energy Strategy, 2013
- Biomass Energy Strategy, 2017
- National Energy Efficiency Strategy, 2019
- Environment Friendly Transport Policy, 2014
- Second Nationally Determined Contribution, 2020

The National Climate Change Policy encourages for production and use of energy efficient technologies. The use of energy efficient technologies and electrical energy are also encouraged for use in industry, transport and physical infrastructure sector. Under this sector, the policy also encourages use of electrical vehicles. Similarly, the second NDC proactively targets for 5000 MW (unconditional) in terms of energy generation and that 15 percent of total energy supplied in 2030 would come from the clean sources. For energy use in transportation, NDC targets have been set to increase sales of e-vehicles to cover 90 percent of two-wheeler and 60 percent of four-wheeler

[1] https://datacommons.org/place/country/NPL?topic=Environment accessed on 17 Dec 2020.

passenger vehicles by 2030 thereby lowering the emission by 28 percent compared to the baseline. Use of electricity as primary mode of cooking in 25 percent of the households thereby lowering the emission by 23 percent compared to the baseline by 2030.

2.2 Bus Rapid Transit

2.2.1 General Description of BRT System

A Bus Rapid Transit system (BRT) is a high-capacity transport system with its own right of way, which can be implemented against relatively low cost. It is a key technology in cities in developing countries, which can change the trend of more private vehicles towards public transportation, thereby bringing about a range of benefits, including reduced congestion, air pollution and greenhouse gases and better service to poor people. Its main drawback compared to other urban transport systems is its demand for urban space. To be most effective, BRT systems (like other transport initiatives) should be part of a comprehensive strategy that includes increasing vehicle and fuel taxes, strict land-use controls, limits and higher fees on parking, and integrating transit systems into a broader package of mobility for all types of travellers.

2.2.2 Barrier Identification for BRT System

a. Economic and Financial Barriers

- High investment costs for modern means of mass transportation might be burdensome for Nepal
- Infrastructure cost with long gestation period is likely to demotivate investors concerning the investment insecurity.
- High interest rates on loans, high operation and maintenance costs due to high labour cost and inflation in the market is likely to demotivate investors.

b. Technological

- The technology is new to Nepal and the existing technical knowledge and practices needs significant improvement to execute the relatively new concept of the mass transit.
- The problem of continuous operation and maintenance might not be solved with the present level of skill manpower and resources.
- Weak dedicated infrastructure (no lane and flyover) at present is also the barrier for BRTs.
- This technology requires reliable supply of required fossil fuel (Euro III and IV) which is not available in the country at present.

c. Policy Barriers

- National Urban Policy 2007 adopts measure to promote vehicles for mass transportation. Although, the policy measure intrinsically promotes the BRT technology, specific policy measure for the promotion of BRT is yet to be formulated.

- High import tax and excise duty (more than 238% for vehicles) are major barriers for investment in BRTs.

d. Institutional Barriers

- Executing BRT demands coordinated efforts by several agencies from the federal to the local level. The regular decision making process in case of BRT therefore can be expected to be more bureaucratic that might cause delays and cost overrun.

e. Environmental Barriers

- GHG emission through fossil fuel use and higher level of environmental risks associated with infrastructure construction are likely to attract resistance towards project on environmental grounds.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in the establishment of BRT technology is presented in Figure 5.

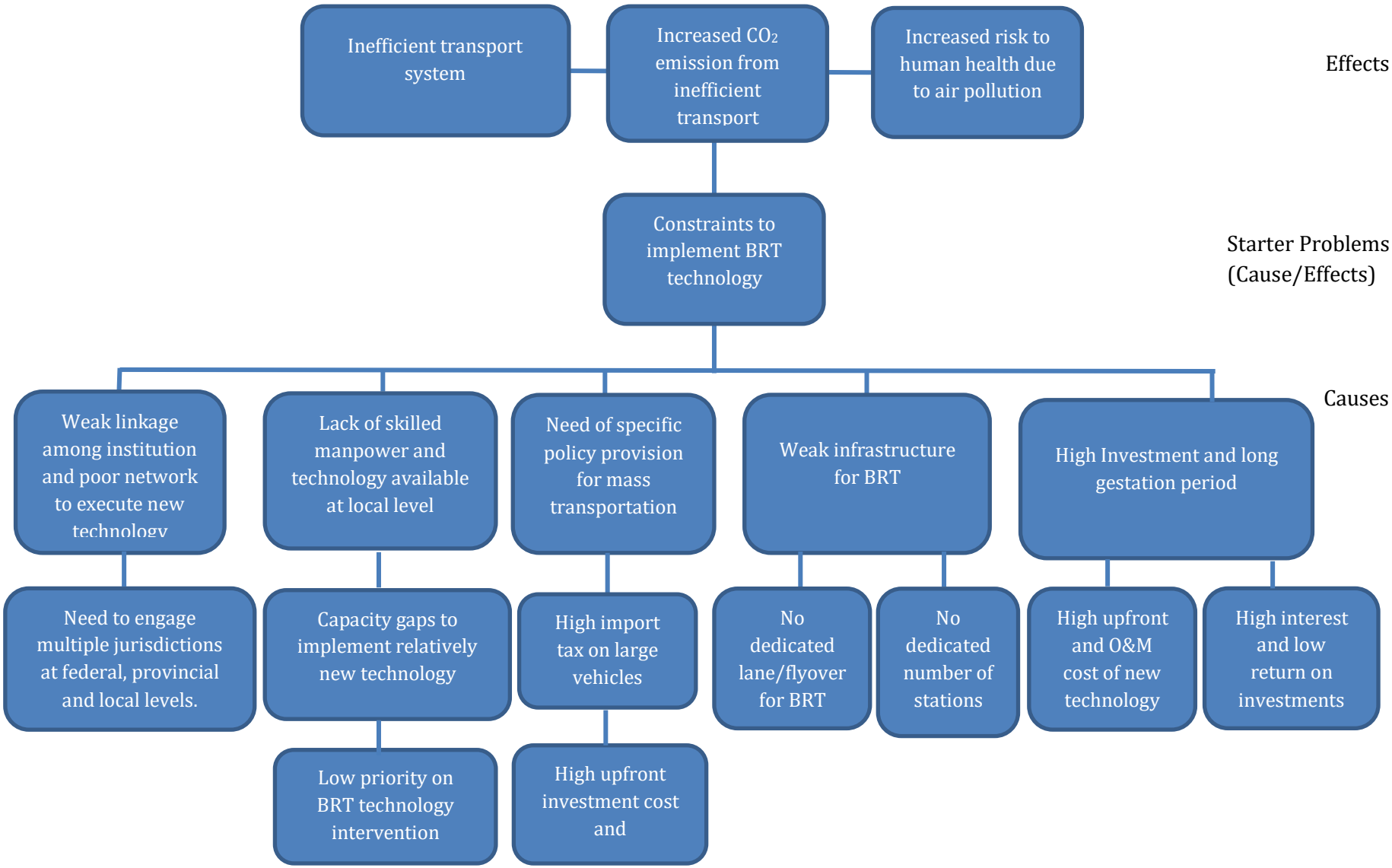

Figure 5: LPA for financial/non-financial barriers in implementing BRT system

2.2.3 Measures to Overcome Barriers for BRT Technology

Possible solutions to address the barriers for the transfer and diffusion of BRT are:

a. Economic and financial measures

- Relax the excise duty for the vehicles to be imported to operate in BRTs.
- Provision of soft loan facilities or tax rebate for BRTs as efficient technology.
- Reasonable BRT fares with scientific method rather than existing methods.
- Creation of financing mechanisms and loan incentives with less interest rate can attract potential investors in BRTs.

b. Non-financial measures

Policy measures

- Creating policy measures to leverage private sector investment is likely to build investor confidence and therefore increase the private investment in BRTs.
- Emphasis on efficient mass transport by government for less emission from road transportation.
- Policy reform to reduce excise duty and taxes to encourage implementation of BRT can be possible solution to deal with high upfront cost.

Environmental measures

- Development of infrastructures like dedicated lanes and flyovers for BRTs.
- Efficient BRT services with less emission as compare to existing diesel vehicles with high emission of particulate matter.

Technical measures

- Prioritization of research and development works for BRT.
- Infrastructure development by both government and private sector with assured investment.

Institutional measures

- Development of synergies among all level of governments and stakeholders
- Establish a separate institution with authority to deal with several institutions involved in the technology implementation.

The LPA for the measures to overcome the barriers in implementing BRT is shown in the Figure 6 while Table 5 presents TAP for the introduction of BRT technology.

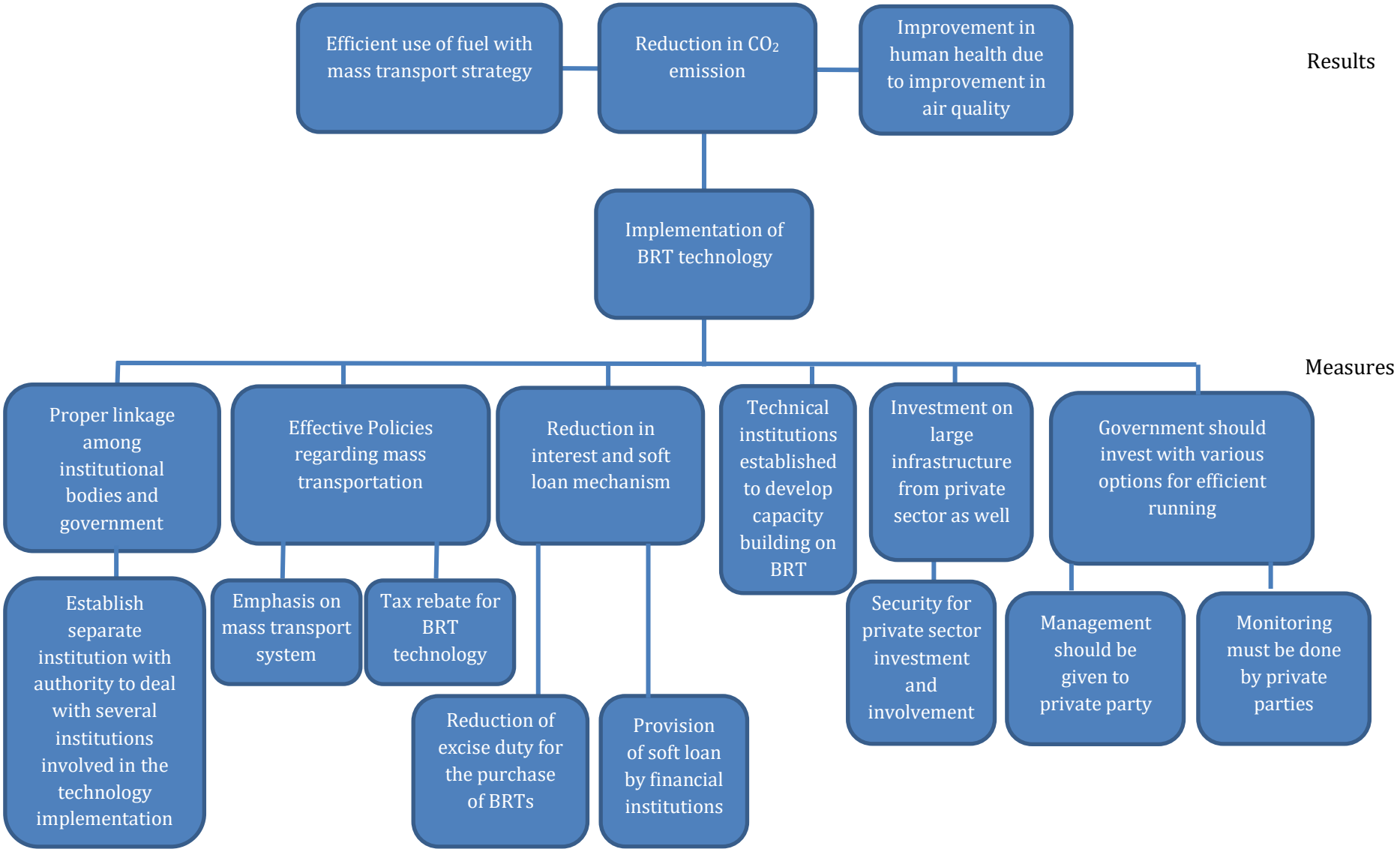

Figure 6: LPA for financial/non-financial measures in implementing BRT system

Table 5: TAP for Introduction of BRT System

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale	MRV by which organization	Estimated Costs in USD
Creation of Network								
1	Creation of stakeholders network	Medium	Networks and channels are the platform for the flow of information	Stakeholders	By studying different alternative routes	Within 2 years	Ministry of Physical Infrastructure and Transport	25,000
Policy and Measures								
2	Control on number of small and private vehicles	High	Root cause of inefficient transportation system	Government bodies and traffic control system	By making proper law and regulation	5 years	Ministry of Physical Infrastructure and Transport	40,000
3	Revising of policy regarding mass transportation	High	Initial phase of any planning is policy	Ministry of Physical Infrastructure and Transport	By continual updating method	1 years	Government's policy making body	15,000
Market Support Actions								
4	Finance system	Medium	Ultimately, money is the key factor	Private and government finance company, banks etc.	Soft loans provision	5 years	Ministry of Finance	50,000
5	Travelling fare	High	It denotes the individual capacity	Different scientific evaluation committee	Scientific per passenger km method	1 years	Ministry of Physical Infrastructure and Transport	10,000
Skills, training and education								
6	Awareness related to social and environmental benefits	High	For diffusion of information	Different institute and organizations	Campaign, meeting, workshop etc.	10 years	Different NGOs, INGOs	100,000

2.3 Electric Cook Stove Technology

2.3.1 Technology brief

Electric cook stove is selected primarily for urban Nepal where access to electricity is easy and availability is high. Most of urban areas are grid connected thus electricity is readily available provided that the power supply is reliable. Electricity has become cheaper source of cooking because of accelerating import cost of LPG used for cooking. As of now the Government has plans in place to promote electric cooking technology so as to reduce dependency on fossil fuels that is affecting our economy.

2.3.2 Barrier Identification for Electric Cook Stove

Dissemination of the electric cook stove might face barriers owing to the low consumer demand because of not so well developed market supply chain and consumer confidence towards the technology. Further the electric stoves are also likely to face competition from the LPG because of its well established distribution network and limited technical know-how required to operate LPG stoves. There is a gap in the supply network and consumers for the easier deployment of electric cook stoves. Main barriers of technology diffusion of Electric Cook Stove are presented below.

a. **Economic and Financial Barriers**
   - Extra costs to upgrade to higher current supply for using electric cooking appliances
   - Additional costs towards cooking utensils with induction base.

b. Technology Barriers
   - Inadequate load bearing system in rural areas
   - Immense rise in peak load demand and electricity distribution challenge during the peak load demands.

c. Policy Barriers
   - Need of policies to discourage LPG use and encourage the use of electric cook stoves.

d. Institutional Barriers
   - Competitive barriers led by LPG with widespread distribution network.
   - Distribution network of electric cook stoves is narrow

e. Social Barriers
   - Inadequate knowledge of new technology and resistance to change.
   - Electricity supply is yet to be perceived as reliable source of energy.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in the establishment of electric cook stove technology is presented in Figure 7.

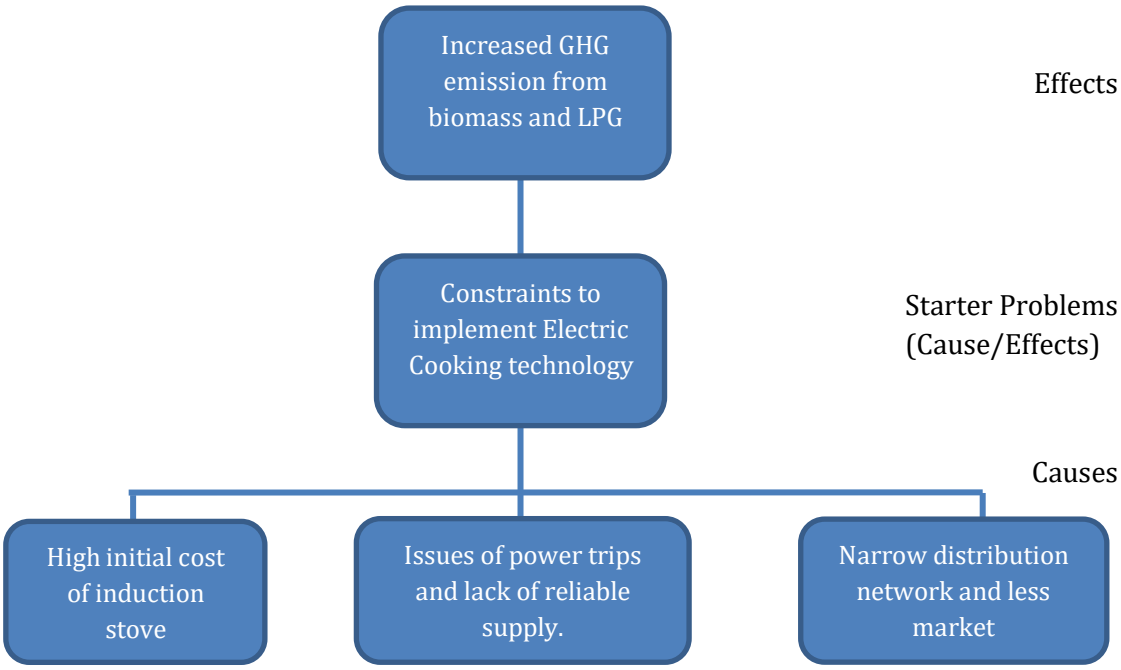

Figure 7: LPA for financial/non-financial barriers in implementing electric stove technology

2.3.3 Measures to overcome Barriers for Electric cook stove Technology

Possible solutions to address the barriers for the transfer and diffusion of electric cook stoves are:

a. Economic and Financial Measures

Development of additional hydropower and other renewable energy generation plants to increase electricity supply. Since demand for electricity is accelerating, focus should be on investment in hydropower development. As electricity for cooking is cheaper, environment friendly and reliable, most urban people ardently use this source provided that the supply is smooth. Differential electricity tariff should be set so as to reduce peak load and hence ensure optimum use of electricity.

b. Non-financial Measures

- Make supporting policies for extension of robust electricity distribution network
- Promotional strategies for electric cook stoves with principle of positive discrimination to encourage its use.
- Development of service and distribution centers in semi urban areas for optimum use of the technology

The LPA for the measures to overcome the barriers in implementing Electric Cook Stove technology is presented in Figure 8.

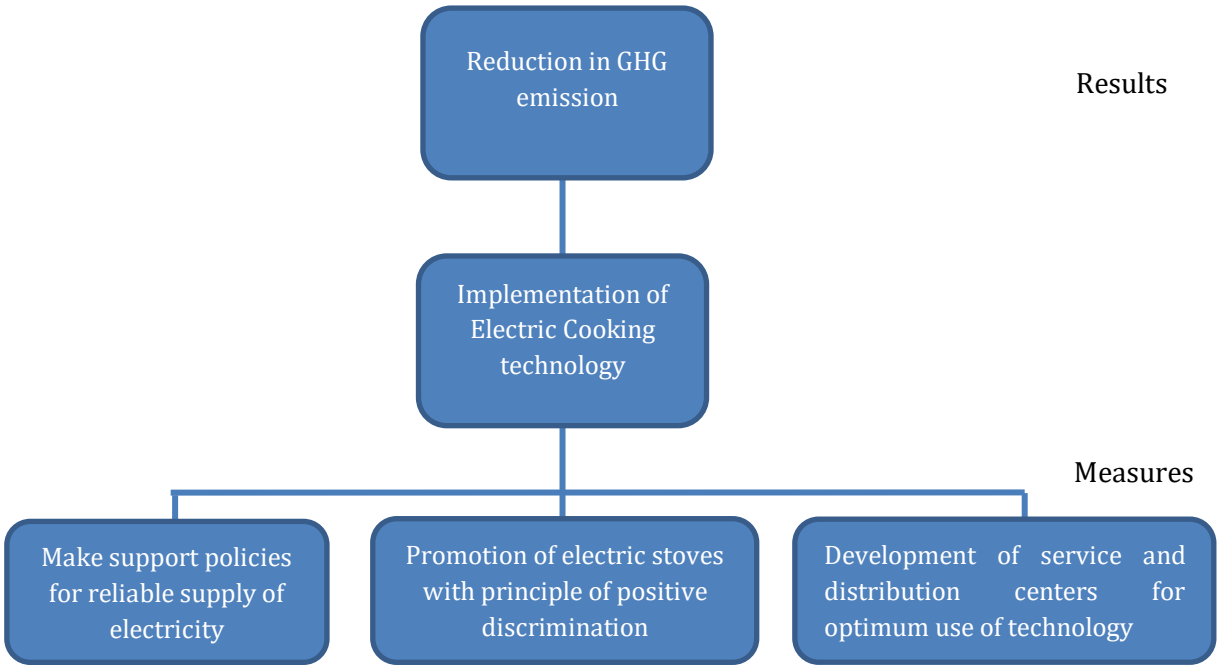

Figure 8: LPA for financial/non-financial measures in implementing electric stove technology

2.3.4 Technology Action Plan for Electric cook stove Technology

Based on the assessment of the technological needs, barriers and measures, technology action plan has been prepared for the electric cook stove technology whichis presented in Table 6.

Table 6: TAP for introduction of Electric Cook Stove Technology

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (Years)	MRV by which organization	Estimated Costs $(1000)
Economical/Financial								
1	Strengthening and creating national focal centers	High	To manage the distribution network and to support R&D	AEPC, MOEWRI	Creating a network of experts. Provide management and technical training.	5	AEPC, MOEWRI	20
Policy and Measures								
2	Make support policies for fundamental and long-term research	High	To enhance research work	AEPC, MOEWRI	Creating a network of experts.	3	AEPC	10
3	Implement appropriate subsidy mechanism	Medium	To expand the scope of application of technology	AEPC	Revise the subsidy mechanism	2	AEPC	20
4	Formulate logical plans and implement effective plan and policies	Low	Policies should be locally appropriate	AEPC, MOEWRI	Develop and promulgate policies to support the promotion of technology	5	MOEWRI	15
Organization/Behaviour Change								
5	Support organizations and individual experts in the research of the technology	Medium	There is lack of specialized units	AEPC, MOEWRI	Consult with stakeholders and experts	3	AEPC, MOEWRI	20
6	Institutionalize the technology	High	To create consistency in dissemination	AEPC, MOEWRI	To develop appropriate regulations. To promulgate and implement regulations	5	AEPC, MOEWRI	10
7	Develop human capacity for planning and construction of biogas plants, as well as institutional	Medium	To facilitate the development of technology	AEPC, MOEWRI, private organizations	Organize training management skills.	5	AEPC, MOEWRI	40

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (Years)	MRV by which organization	Estimated Costs $(1000)
	infrastructure to lead technological aspects of biogas projects including getting of standards, inspection, certification etc.							
Market Support Actions								
8	Localize products to adapt the local end-users	High	To flourish market	AEPC, private organizations	Promote the technology	2	AEPC	60
Skill, Training and Education								
9	Skill development training to the local artisans for the installation and manufacturing of the efficient plant	High	To ensure the process of technological innovation	AEPC, private organizations	Develop training programs. To provide training.	2	AEPC, private organizations	45
10	Undertake public education and awareness for efficiency improvement and related implications	High	To create an important premise for the dissemination of technology	AEPC, private organizations	Develop awareness campaign programs.	2	AEPC, private organizations	45

2.4 Biogas Technology

2.4.1 Technology brief

Biogas development in Nepal has started in the 1980s as a technological research project with a limited number of test models. It was expanded during the 1990s by the Biogas Support Program (BSP) into a successful market development program with the active involvement of the business community. Between 2004/05 to 2016/17, 258,811 biogas installations have been made. The purpose of choosing this technology for the analysis was to improve energy access throughout the country. There are still numbers of barriers hindering the dissemination of biogas plant in most of rural and remote areas. Penetration of biogas plant in such places is still lagging. Rural and remote areas of mid-hill and Tarai with limited access to grid electricity still depend on traditional biomass fuel for cooking. Thus, biogas plant is to be promoted to such places with adequate monitoring and supervision for sustainability.

2.4.2 Barrier Identification for Biogas

Scarcity of cheap capital hampers development of new technologies. Banks are issuing loans at high interest rate and only under firm collateral guarantee. There are few, if any, cases of project financing based on business plans. On the consumer side, the cost of biogas stove seems high for most of the rural dwellers. On the production side, financing on production technology is problematic for small workshops that are currently manufacturing the stoves. The needed additional finance to increase the capacity and introduce new material and design may be unaffordable for these small workshops. Neither negative externalities (pollution, environmental damage) from conventional technology are considered in pricing, nor are positive impacts of climate technologies valued. Correspondingly, there is no mechanism for accounting for environmental benefits that might result from application of efficient technologies and highly efficient stoves in particular.

a. Economic and Financial Barriers

- High initial cost
- Limited Research & Development (R&D) activities for cost reduction of technology and introducing better prototypes.

b. Technology Barriers

- Need to strengthen existing maintenance services.
- High labour requirement (daily) for the production of biogas
- Poor animal husbandry practices that result in inadequate availability of waste material for the generation of biogas. Thus, the success of biogas units are more dependent on the availability of dung and water.

c. Policy Barriers

- Biogas units from Nepal have been continuously generating revenues through the trade of emission reductions. However, mechanism to re-channel the revenue for better operation of the existing units is still lacking.
- Over the time, the technology efficiency gets reduced and mechanism to tackle this through long term plant rehabilitation program is required for the sustained use of existing technology and to attract more new consumers.

d. Institutional Barriers

- Despite the strong installation network, quality control system is more centralized.
- Dissemination of the technology is still targeted at the household level and there is limited capacity to expand the focus towards more commercially viable biogas systems and technologies at commercial or institutional level.

e. Social Barriers

- Shifting social values of rearing a livestock at household towards more consumer oriented values to purchase milk.
- Cumbersome process at the household level to prepare dung for the generation of biogas.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in the implementation of biogas technology is presented in Figure 9.

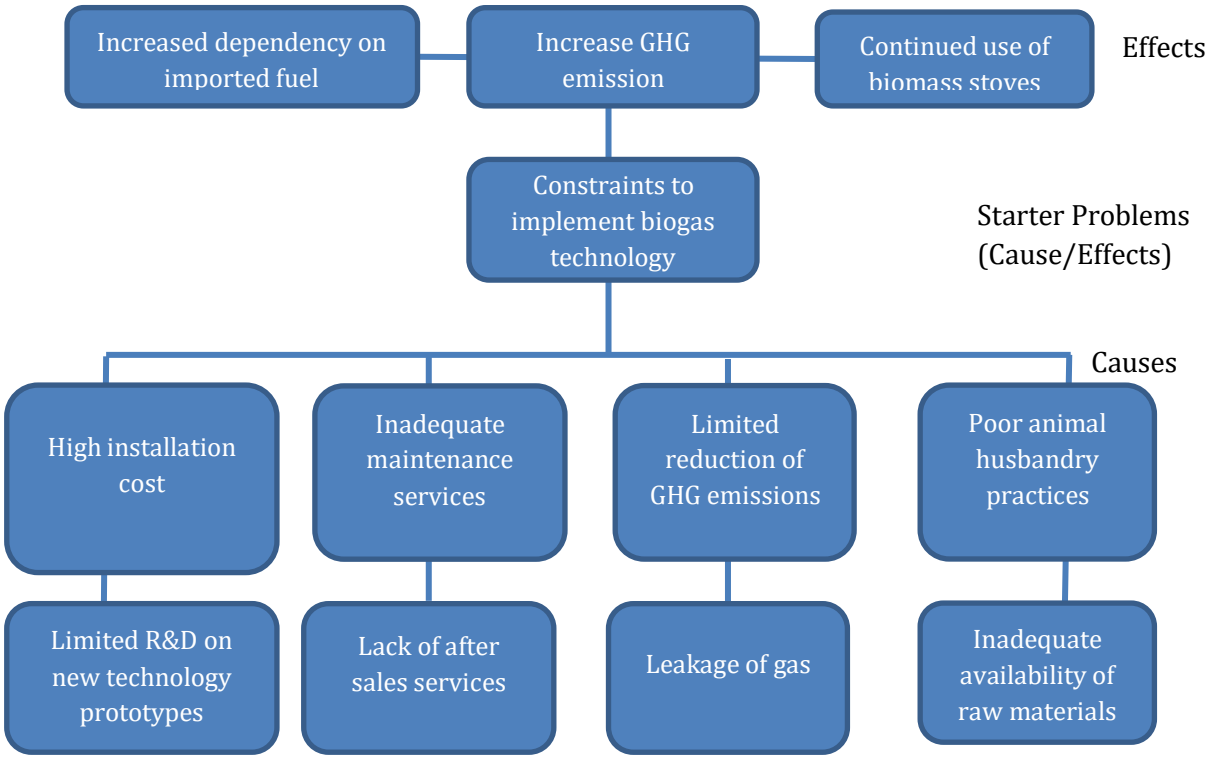

Figure 9: LPA for financial/non-financial barriers in implementing biogas technology

2.4.3 Measures to overcome Barriers for Biogas Technology

The problem tree (Figure 9) is reformulated to objective tree (Figure 10) in order to identify the measures for the barriers identified. The stakeholder consultation identified the measures listed below.

a. Economic and Financial Measures

High initial cost is hindering the penetration of biogas in Nepal. Despite biogas has been implemented with subsidy to households, its costs could be lowered through the identification of new prototype of the biogas digester. By far, the GGC 2047 model is almost the sole technology that has been promoted in Nepal with subsidy. Corporate support can be provided for easy financial access. Soft loan can be attractive for further dissemination of plants. Necessary credit facilities and other additional incentives can promote biogas plants in most places where households are rearing livestock.

b. Non-financial Measures

- Provide funding to support development of policies and public awareness programme
- Biogas can be used as clean renewable energy source in replacement of low efficient animal dung, agri-residue and traditional cook stove
- Develop human capacity for planning and construction of biogas plants, as well as institutional infrastructure to lead technological aspects of biogas projects including standards, inspection, certification etc.
- For raw material collection, animal husbandry practice can be encouraged at users' level
- Skill development training and awareness programmes to the local artisans for the installation and manufacturing of the efficient plant and
- Undertake public education and awareness for efficiency improvement, effectiveness and sustainability

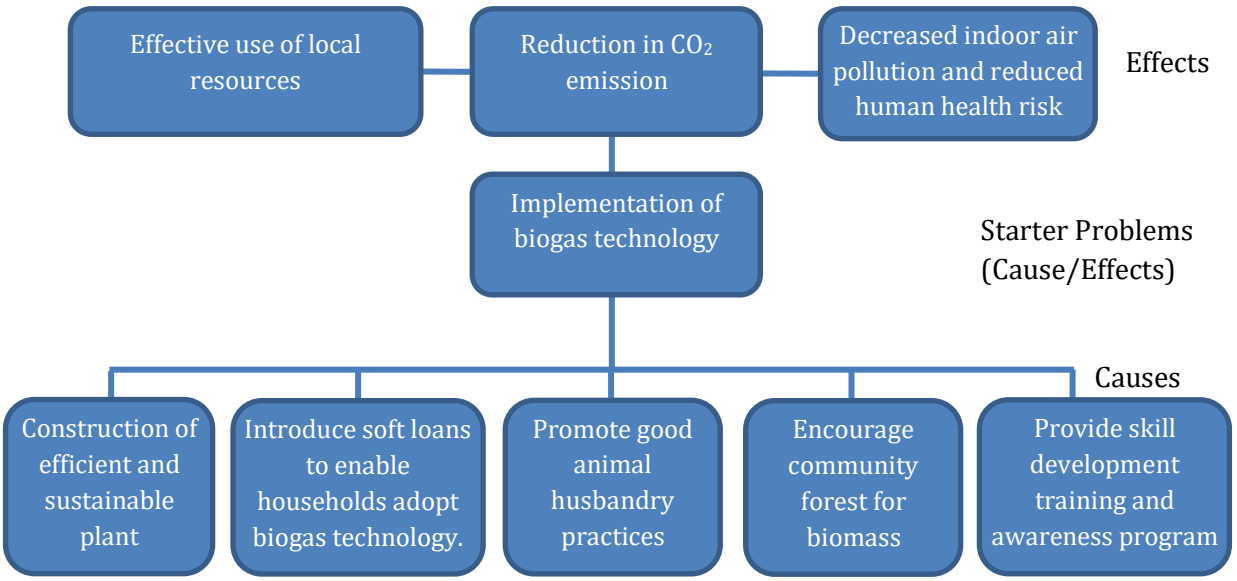

Figure 10: LPA for financial/non-financial barriers in implementing biogas technology

2.4.4 Technology Action Plan for Biogas Technology

Based on the assessment of the technological needs, barriers and measures, technology action plan has been prepared for the biogas technology. TAP for the biogas technology is presented in Table 7.

Table 7: TAP for introduction of Biogas Technology

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (Years)	MRV by which organization	Estimated Costs $(1000)
Creation of Network								
1	Strengthening and creating national focal centers	High	To manage the distribution network and to support R&D	AEPC	Creating a network of experts. Provide management and technical training.	5	AEPC, MOEWRI	20
Policy and Measures								
2	Make support policies for fundamental and long-term research	High	To enhance research work	AEPC, MOEWRI	Creating a network of experts.	3	AEPC	10
3	Implement appropriate financing mechanism	Medium	To expand the scope of application of technology	AEPC	Revise the subsidy mechanism	2	AEPC	20
4	Formulate policies to sustain the use of biogas technology over time.	Low	Policies should be in place to ensure that the plants once installed are operating through its life.	AEPC, MOEWRI	Develop and promulgate policies to support the rehabilitation of technology.	5	MOEWRI	15
Organization/Behaviour Change								
5	Support organizations and individual experts in the research of the technology	Medium	There is lack of specialized units	AEPC, MOEWRI	Consult with stakeholders and experts	3	AEPC, MOEWRI	20
6	Develop human capacity for planning and construction of biogas plants, as well as institutional infrastructure to lead technological aspects of biogas projects including getting of standards,	Medium	To facilitate the development of technology	AEPC, MOEWRI, private organizations	Organize trainings	5	AEPC, MOEWRI	40

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (Years)	MRV by which organization	Estimated Costs $(1000)
	inspection, certification etc.							
Market Support Actions								
7	Localize products to adapt the local end-users	High	To flourish market	AEPC, private organizations	Promote the technology	2	AEPC	60
Skill, Training and Education								
8	Skill development training to the local artisans for the installation and manufacturing of the efficient plant	High	To ensure the process of technological innovation	AEPC, private organizations	Develop and conduct training programs	2	AEPC, private organizations	45
9	Undertake public education and awareness for efficiency improvement and related implications	High	To create premises for the dissemination of technology	AEPC, private organizations	Develop awareness campaign programs.	2	AEPC, private organizations	45

2.5 Linkages of the barriers identified in Energy Sector

During the analysis process, many barriers and other obstacles of the system were identified which could be common to all technologies, and just a few of which would become specific for a certain technology and sector. The aggregation and summary of the common barriers of technology in the Energy sector is presented in Table 8.

Table 8: Linkages between the barriers in Energy sector

Barrier	Technologies		
	Bus Rapid Transit	**Biogas**	**Electric Cook stoves**
Economic/ Financial	- High investment costs for the infrastructure and long gestation period that inhibit investment confidence. - High interest rate on loans - High operation and maintenance costs due to labor costs and high inflation.	- High initial cost - Limited R&D activities for cost reduction of the technology and introduction of better prototypes.	- Extra costs to upgrade to higher current supply. - Additional costs towards cooking utensils with induction base.
Policy	- Policy gap in existing transport and urban policies to specifically address BRT technology. - High import tax and excise duty.	- Need of mechanism to re-channel the carbon revenue generated from operating biogas units to ensure sustainable operation of those units. - Need of policy for plant rehabilitation program for sustained use of biogas operating at low efficiency or have ceased operating.	- Need of policies to discourage LPG use and encourage use of electric cook stoves.
Technical	- Limited knowledge about the technology and improvement needs mass transport execution approach. - Weak infrastructure for BRTs	- Need to strengthen existing maintenance services. - High labor input for biogas production. - Poor animal husbandry practices resulting in inadequate raw materials.	- Significant rise in peak load demand and distribution challenges during the peak load hours.
Market support systems	- Long gestation period - Need of coordinated efforts among several agencies from the federal to local levels make the decision making process more bureaucratic. - Higher investment costs in infrastructure without relaxation in tax and excise duties is likely to make the services expensive for adoption.	- Shifting social values regarding rearing of livestock. - Cumbersome process to generate biogas.	- Inadequate technological knowledge and social resistance to change. - Widespread perception that the electricity is yet to be the reliable source of power supply.

2.6 Enabling framework for overcoming the barriers in Energy Sector

In order to identify barriers in this Sector, experts have come up with the following measures for each prioritized technologies. (Table 9)

Table 9: Enabling Framework in Energy Sector

Barriers	Measures
Bus Rapid Transit	
- Policy gap in existing transport and urban policies to specifically address BRT technology. - High investment costs for the infrastructure and long gestation period that inhibit investment confidence. High import tax and excise duty. - Need of coordinated efforts among several agencies from the federal to local levels is likely to make the decision making process more bureaucratic. - Weak infrastructure for BRTs	- Emphasis on efficient mass transportation by government for less emission from road transportation. - Formation of separate policy with better policy measure to leverage private sector investment to build investor confidence attract investments. - Policy reform to reduce excise duty and taxes to encourage implementation of BRT. - Establish a separate institution with authority to deal with several institutions involved in the technology implementation. - Development of infrastructures like dedicated lanes and flyovers for BRTs.
Biogas Technology	
- High initial installation cost of biogas plant - Need of mechanism to re-channel the carbon revenue generated from operating biogas units to ensure sustainable operation of those units. - Need to strengthen existing maintenance services.	- Focus on R&D for the identification of new prototype of the biogas (other than GGC 2047 model) that might be prepared at lower cost. - Introduction of soft loan schemes and micro-credits for the households - Promote better animal husbandry practices for better yield of raw materials - Provide skill development training and awareness program
Electric Cook Stoves	
- Extra costs to upgrade to higher current supply and additional costs towards cooking utensils with induction base. - Need of policies to discourage LPG use and encourage use of electric cook stoves.	- Enhance generation of electric power through development of additional hydropower projects. - Differential electricity cost reduce burden at peak load - Development of service and distribution centers in semi urban areas for optimum use of the technology.

CHAPTER-3: FORESTRY SECTOR

3.1 Overview

Forest is one of the most important resources for Nepal and it is a major form of land-use occupying 5.98 million hectares (40.36%) of total area of the country (FAO, 2020). The contribution of agriculture, fisheries and forestry combined to the national GDP was 27.7 percent in FY 2019/20. Forest Act, 2019 classifies national forests into government managed forests, protected forests, community forests, leasehold forests, religious forests, collaborative forests, and forest conservation areas. There are 22415 community forest user groups managing almost 2.3 million hectares (38.5%) of total forest area (MoF, 2020). Forests provide important ecosystem services to the world. These services are categorized into four groups which are supporting, provisioning, regulating and cultural services (like biodiversity, fuel wood, water, tourism, etc.). Carbon regulating service of forests is an important ecosystem service in the context of climate change mitigation.

Forest is an area of land at least 0.5 ha and a minimum width of 20 m with a tree crown cover of more than 10% and tree heights of 5m at maturity. According to Forest Act 2019, forest is defined as all the area which is fully or partially covered by trees. Forest Research and Training Center (the then Department of Forest Research and Survey) has been conducting the national scale forest resource assessment at defined intervals. The latest forest resource assessment was completed in 2014 which shows total forest area 5.98 million hectares along with other wooded land that occupies 0.65 million hectares.

Nepal has adopted several policies and strategies for conservation and management of forest ecosystems. Key guiding policies and strategies for the forestry sector include:

- The Fifteenth Plan (2019/20-2023/24)
- National Forest Policy, 2019
- National Climate Change Policy (NCCP), 2019
- National Environment Policy, 2019
- Nepal's Forest Sector Strategy, 2016-2025
- National REDD+ Strategy, 2018
- Second Nationally Determined Contribution (NDC), 2020

In the NCCP, the forest, biodiversity and watershed conservation sector outlines strategy to increase forest carbon sequestration by adopting sustainable forest management practices. Similarly, the second NDC aims to maintain 45 percent of the total area of the country under forest cover by 2030. Similarly, by 2030, NDC targets to manage 50 percent of Tarai and Inner Tarai forests and 25 percent of middle hills and mountain forests sustainably, including through the use of funding from REDD+ initiatives.

3.2 Silviculture Technology

3.2.1 Technology brief

Silviculture systems could be broadly divided into two systems, i.e. selection system (polycyclic) and shelter wood systems (monocyclic). The selection system aims to keep all-aged stands through timber cuttings at shorter intervals. Many light cuttings are made. Seedlings will become established in small gaps. Under this system, two or more intensive harvests are possible during one rotation. The selective felling of exploitable trees is done over an area at periodic intervals. The shelter wood system is introduced usually when it becomes necessary to harvest more intensively and regeneration is not assured under the selection system. Basically, the shelter wood system attempts to produce a uniform crop of trees from young regeneration through both heavy harvesting and broad silviculture treatments. A new even-aged tree is established by applying preparatory and establishment cuttings to natural regeneration (i.e. seedlings and saplings) of the desired trees. At an appropriate time, the remaining over-storey is removed.

In Nepal, there are different types of forest which require application of silviculture based forest management in order to increase productivity of forests; mitigate climate change, and generate incomes to local people. In total, Nepal has 5.8 million hectares of forests, but forest products like timber is not enough to meet the demand. So, cost of timber is very expensive. As the result, Nepalese are importing timber from the countries like Indonesia and Myanmar. In addition, aluminum door and window frames are used instead of wooden one. Therefore, increasing forest productivity through application of silviculture is very important as it can increase incomes and carbon stocks.

3.2.2 Barrier Identification for Silviculture Technology

The team of experts involved in Technology Needs Assessment carried out the participatory approach in identifying the barriers in the diffusion of the technology. Relevant national policies, strategies and pertinent reports were reviewed in an endeavor to identify reasons for the awaiting application of the technology. This was further carried out with the roster of experts involved in the research institutions on the possible policy and institutional barriers that inhibit the acceleration of research and development on the technology. The long list of barriers was compiled under the headings namely policy, institutional, economic, environmental and technical barriers. Later the barriers were grouped into two categories viz. economic and financial barriers, and non-economic barriers.

a. Economic and Financial Barriers

Allocation of adequate resources constraints the application of silviculture technology for many community based forest management groups. Moreover, the mitigation of GHG from the forest sector is yet to be functional at full scale. To this end, the Nepal is prepared with the strategy and necessary set-ups to implement Reducing Emission from Deforestation and Forest Degradation (REDD+) program for the transaction of emission reductions realized as part of carbon

sequestration from forests. Moreover, there are financial barriers resulting as part of limited budget allocation in research and development to map the potential forest areas and types to implement effective silvicultural practices for better wood yield and at the same time lower the emission trajectory.

b. Technical Barriers

Limited scientific data on silvicultural practices and ecosystem management hinders the implementation of the technology. For the implementation of the technology capacity of the government at all levels and their related institutions need to be strengthened. The "know-how" of the technology need further research, exploration and verification in the context of sustainable management of forest. Improved forest harvesting and logging practices (also called as reduced impact logging for climate) can deliver climate change mitigation outcomes by reducing emissions while maintaining timber production.

c. Policy Barriers

Environmental policy and similar regulations play a key role in the implementation of the technologies. There should be clear policy regulations in relation to the technology and its relationship with mitigation of GHGs. National policies on the forest management are more focused on protecting and managing the forests, but intensive management and timber harvest is equally important in maintaining the forest ecosystems productivity and GHG emission reduction. Similarly, the policies and legal instruments recognize roles of stakeholders in better forest management as evident by the management approaches like community forests, collaborative forests, leasehold forests and government managed forests. However, community forest management practice seems to prevail among other management approaches and other management approaches needs to be scaled-up further.

d. Institutional Barriers

Institutional barriers are assessed with regards to the gaps in integrated and coordinated efforts within different government agencies and across all levels of government. Community based forest management is a widely used approach to manage forest resources in Nepal, where many small forest user groups are managing small patches of forests. Strengthening of research institutions and universities on introduction and demonstration of new technology is also needed. Moreover, establishment of multi-stakeholder coordination mechanisms is desirable to enhance stakeholders' participation for better implementation of the technology.

e. Environmental Barriers

Maintenance and protection of forest resources are often faced with many challenges like topography and climate components. The variation in topography and climatic distribution of the country stands as major barrier. For sustainable forest protection and management, an effective system of uniform standards needs to be developed. However, considering diverse and complex forests of Nepal developing an uniform standard may not address the specific local conditions.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in implementation of silviculture technique is presented in figure 11.

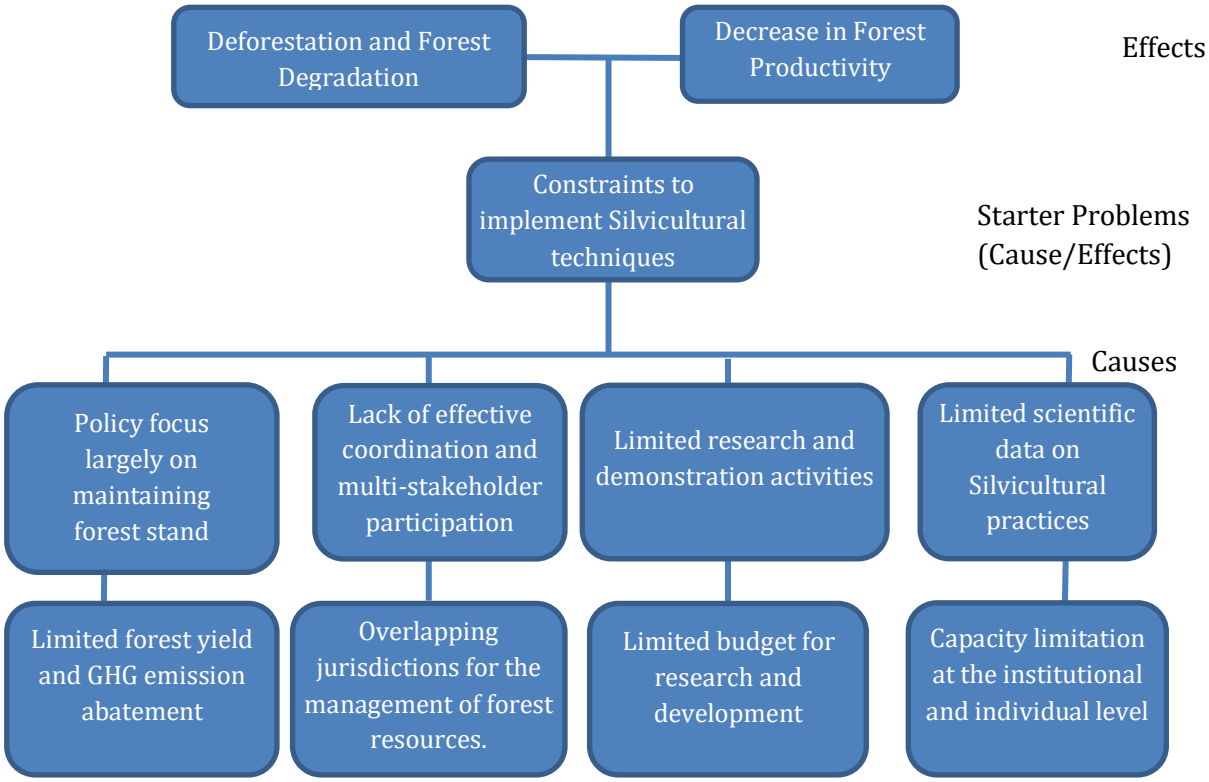

Figure 11: LPA for financial/non-financial barriers in implementing silviculture technology

3.2.3 Measures to overcome Barriers for Silviculture Technology

Identifying measures is simply the process that enables or motivates a particular course of action or behavioral change with the objective of overcoming barrier towards implementation of the technology. The measures considered should sustain all the levels of involvement viz. innovation, R&D, deployment and diffusion.

Policy measures of in-country and out-country were considered as an important input to the process. Technology Transfer Perspective Series developed by UNEP RISO Centre was utilized as the guidebook to prepare enabling frameworks for the technology. This also involved the same procedure as of identification of barriers and the measures were mainly grouped under two headings. The measures were devised such that it presents the way forward from problems to solutions.

a. Economic and Financial Measures

The following measures are proposed with an objective to overcome the economic and financial barriers of the technology:

- Additional resource allocation for the research and development of the technology and explore potential areas suitable to introduce silviculture technology.
- Promote investments of the government, non-government, co-operatives and the private sector in the timber and non-timber forest products based industry.
- Promote forest based enterprise for efficient utilization of the forest products.
- Access international funds in relation to CDM and REDD+.

b. Non-financial Measures

Creation of Network

- Develop a sustainable forest management partnership among different government organizations, NGOs and other civil society organizations.
- Establish a mechanism amongst research institutions, universities and Government departments to demonstrate, test and adopt new technologies.

Policies and Measures

- Introduce policies to enhance forest yield and carbon sink.
- Prepare programs on forest resource database regarding GHG abatement in national implementation plans.

Skills, Training and Education

- Identify the roles of the executing organizations and determine their responsibility.
- Capacitate institutions at all levels to keep abreast with the recent development in technology implementation and enhance knowledge of the human resource involved.
- Conduct specific capacity building activities to increase technical capacity of relevant technical experts and forest management institutions.

Market Support Systems

- Establish local markets to support forest based enterprises.
- Identify and collaborate with bi/multi-lateral entities to implement CDM and REDD+ and trade the emission reductions.

The LPA for the measures to overcome the barriers in implementing Silviculture is shown in the Figure 12.

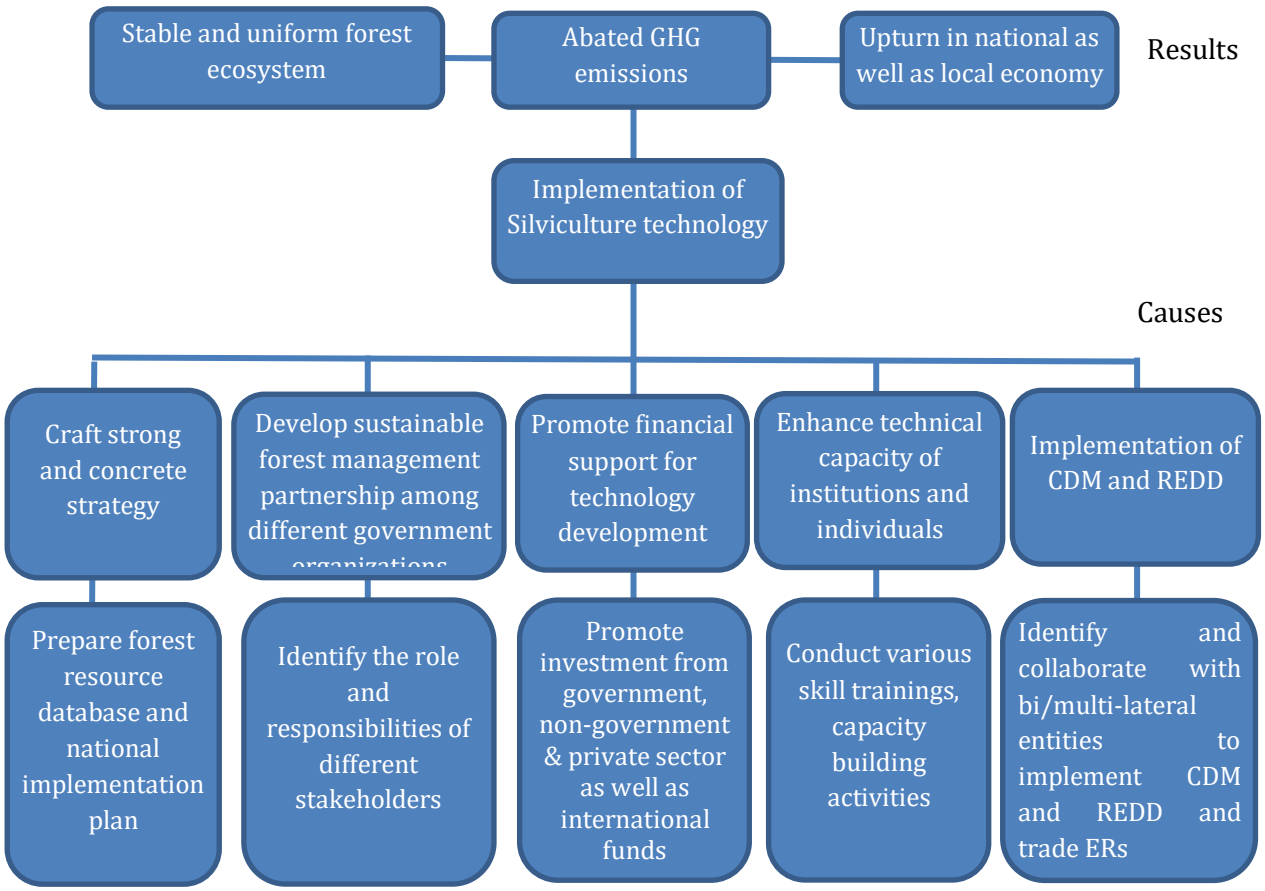

Figure 12: LPA for financial/non-financial measures in implementing silviculture technology

3.2.4 Technology Action Plan for Silviculture Technology

Based on the assessment of the technological needs, barriers and measures, technology action plan (TAP) has been prepared for the silviculture technology. TAP for the silviculture technology is presented in Table 10.

Table 10: TAP for introduction of Silviculture Technology

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (specify date)	MRV by which organization	Estimated Costs in '000' USD
Creation of Network								
1	Formation of network of local stakeholders.	High	It increase capacity of all local stakeholders	Department of Forests and Soil Conservation	Promoting awareness and training to local stakeholders	5 years from the time of start	Ministry of Forests and Environment	Y1: 25 Y2: 25 Y3: 25 Y4: 25 Y5: 25
Policy and Measures								
2	Preparation of forest management plan. Implementation of management plan	High	It is basis for forest management	Department of Forests and Soil Conservation	By participatory and community based mode of program development.	5 years	Ministry of Forests and Environment	60,000+ 206,00= Y1: 332.5 Y2: 257.5 Y3: 257.5 Y4: 257.5 Y5: 257.5
Market Support Actions								
3	Develop concept of tree insurance	High	It helps to minimize risk of damaging forest products	Insurance companies	Promoting ideas in insurance companies	5 years	Ministry of Forests and Environment	Y1: 6.25
Skill, Training and Education								
4	Training on community based application of silviculture	High	It is needed for technology dissemination	Department of Forests and Soil Conservation	By forming pilot projects.	5 Years	Ministry of Forests and Environment	Y1 :125

3.3 Short Rotation Forestry Technology

3.3.1 Technology Brief

Short rotation forestry (SRF) refers to the growing of trees in dense stands, harvested at 3-4 years intervals and regenerated from the stools, which are expected to survive five rotations at least. As a rotation crop, short rotations crops (SRC) is harvested at specific intervals, to provide a regular supply of wood. The development of SRF for renewable energy production is a new sector with potential for considerable expansion, offering benefits for growers, developers, consumers, local communities and the environment. Carbon dioxide removal through afforestation, reforestation and restoration technologies are important area to deliver climate change mitigation outcomes.

Local foresters, producers and communities including forest officers and concessionaries can play crucial role in wider dissemination of the technology. However, limited scientific data on SRC technology is a serious impediment in the application of the technology. So far SRC technology is yet to be established in Nepal and further research is required. However, several Asian countries are practicing the technology which has mitigation potential ranging from 33 tC/ha to 125 tC/ha. The technology can provide added value to the surrounding communities as it offers sustainable harvesting of wood and thus reduces encroachment while offering forest logs for different domestic purposes. Similarly, maintenance of carbon stock and/or enhancement of carbon sinks are always associated with it.

Current national development priorities in linkage with the socio-economic-environmental values are embedded in the technology as it secures social equity, environmental sustainability and economic efficiency. The technology has wider applicability as it adopts socially acceptable programs of forest protection, improving management of community forests and ensuring satisfactory natural regeneration of harvested forests and management capabilities and adopts reduced-impact logging practices. Hence, the technology has no physiographic barrier for implementation in any part of the country. However, road accessibility is a prerequisite which greatly enhances harvesting of woods and transportation to local markets.

3.3.2 Barrier Identification for SRF Technology

The process conducted in identifying barriers involved same procedure as in earlier technology. The barriers were sub-divided into two main headings namely economic and financial barriers, and non-financial barriers.

a. Economic and Financial Barriers

One of the major challenges the technology faces in its implementation will be inadequate investment in research and demonstration of similar technologies. Similarly, uncertainty in pricing of wood products undermine uptake of this technology. Another major barrier in diffusion of the technology is related to the investments done on public access to the transportation facility as it interferes with the transfer of end products to markets.

b. Technical Barriers

There is limited progress on research and development in SRF in Nepal. Proven technologies for specific environmental conditions are required for promotion of short rotation forestry.

In addition, difficulty in selection of an appropriate species according to the local environment prevails as the tree species selected on the basis of market demand may not be suitable to the climatic and environmental conditions of the site.

c. Policy Barriers

The existing policies and plans are yet to realize and establish distinct strategies regarding the enhancement and conservation of forest carbon stocks. This needs further revision and assessment in line with the issues of SRF with concerns of climate change mitigation, CDM and REDD+. SRF demonstration activities to communicate successes achieved are lacking at present. Similarly, there are no provisions of loan against forest resources as the collateral.

d. Institutional Barriers

Despite address of holistic and integrated approaches in forestry policies and implementation plan, SRF is not a priority for any sort of forest management approaches practiced in Nepal. Similarly, there are inadequate numbers of institutions that facilitate the involvement of local communities, farmers, industries and local governments and mobilize them in SRF activities.

e. Environmental Barriers

It is likely to face some difficulties in developing a large area of unplanned forest land into a well-managed short rotation forests. Besides, the variation in topography and climatic conditions of the country can hinder the progress at times.

Logical Problem Analysis (LPA) for the identified economic/financial and non-financial barriers in implementation of SRF technique is presented in Figure 13.

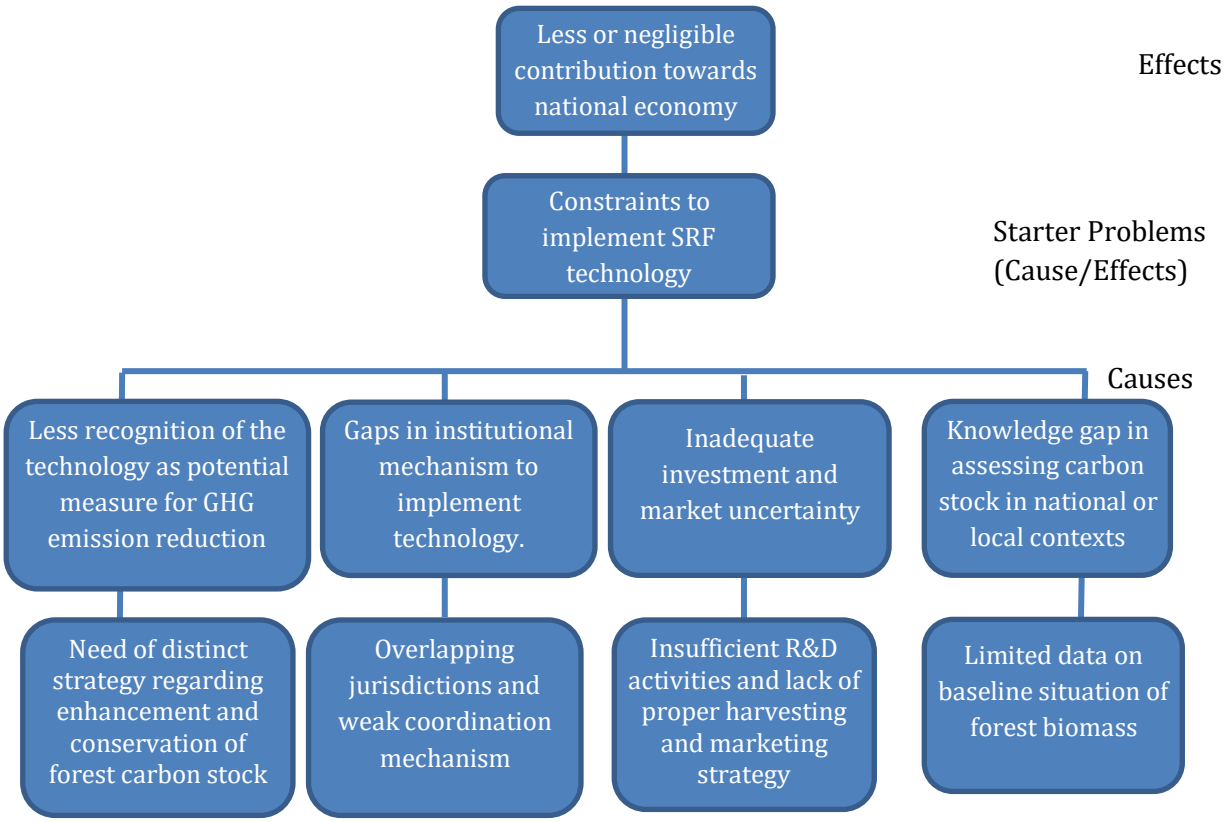

Figure 13: LPA for financial/non-financial barriers in implementing SRF technology

3.3.3 Measures to Overcome Barriers for SRF Technology

a. Economic and Financial Measures

The following measures are proposed with an objective to overcome the economic and financial barriers of the technology.

- Allocate additional resources to support development of SRF technology.
- Promote investments of the government, non-government, co-operatives and the private sector in the timber and non-timber forest products based industry.
- Access and utilize financial resources generated from international mechanisms such as CDM and REDD+.

b. Non-financial Measures

Creation of Network

- Encourage involvement of non-government and private sectors.
- Establish association of forest entrepreneurs for supporting market linkages.

Policies and Measures

- Adopt specific strategies addressing the issues related to SRF for enhancement and conservation of forest carbon stocks.

- Develop a comprehensive guidelines concerning the harvesting, marketing of forest products, pricing, tariffs and quotas for export and import
- Formulate financial policy for preferential credits for forest-based entrepreneurship including SRF.
- Promote use of modern technologies by giving incentives to forest owners/managers.
- Annual land tax waiver for the SRF or private forest growers.

Skills, Training and Education

- Conduct specific capacity building activities to increase technical capacity (for example: improved plantation techniques, invasive species control by using bio control agents, thinning/pruning equipment and technologies, use of efficient harvesting and logging technologies, reduction of waste from harvested tree, biochar and parquet making, high-tech nursery, seasoning and treatment of wood, use of LiDAR and cutting edge technologies for biomass and carbon estimation) in SRF technology.

Market Support Systems

- Perform market feasibility survey for development of internal market and promotion of exports, and disseminate the results
- Establish local markets to support entrepreneurship of the forest user groups
- Identify and collaborate with bi/multi-lateral entities to implement CDM and REDD+ and trade the emission reductions.

The LPA for the measures to overcome the barriers in implementing SRF is shown in the Figure 14.

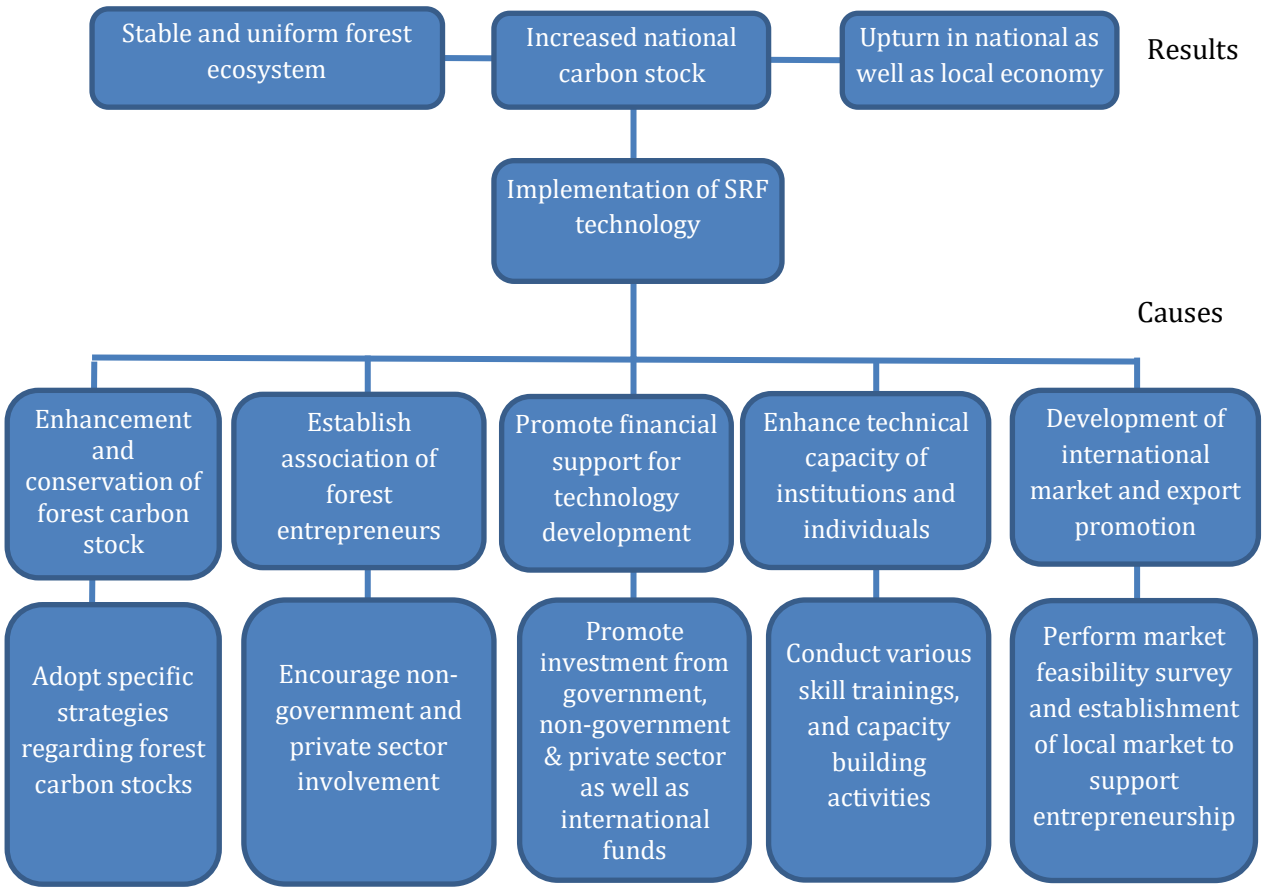

Figure 14: LPA for financial/non-financial measures in implementing SRF technology

3.3.4 Technology Action Plan for SRF Technology

Based on the assessment of the technology needs, barriers and measures, Technology Action Plan (TAP) has been prepared for the silviculture technology which is presented in Table 11.

Table 11: TAP for introduction of SRF Technology

SN	Measures	Priority	Why is it important?	Who should do it?	How should they do it?	Time scale (specify date)	MRV by which organization	Estimated Costs in '000' USD
Creation of Network								
1	Formation of network of local stakeholders	High	It increases capacity of all local stakeholders and increase access to others	Department of Forests and Soil Conservation	Promoting awareness to local stakeholders	5 years from the time of start	Ministry of Forests and Environment	Y1:12.5
Policy and Measures								
2	Preparation of forest management plan. Implementation of management plan	High	It is basis for forest management	Department of Forests and Soil Conservation	By participatory and community based mode of program development	5 years	Ministry of Forests and Environment	31.25+ 900= Y1: 931.25 Y2: 100 Y3: 100 Y4: 100 Y5: 100
Market Support Actions								
3	Develop concept of tree insurance	High	It helps to minimize risk of damaging forest products	Insurance companies	Promoting ideas in insurance companies	5 years	Ministry of Forests and Environment	Y1: 6.25
Skill, Training and Education								
4	Training on management of SRF	High	It is needed for technology dissemination	Department of Forests and Soil Conservation	By forming pilot projects	5 Years	Ministry of Forests and Environment and NGOs	Y1 :125

3.4 Linkages of the barriers identified in Forestry Sector

The major barriers identified in the dissemination/diffusion of the proposed two technologies have many aspects in common. The identified barriers common to both the technologies are summarized in Table 12.

Table 12: Linkages between the barriers in Forestry sector

Barrier	Technologies	
	Silviculture	**Short Rotation Forestry**
Economic/ Financial	- Constraints due to lack of adequate resources for R&D. - Lack of alternative assured funding resources to implement technology.	- Inadequate investment in research and demonstration. - Uncertainty in pricing of wood products.
Policy	- More focus of the national policies on maintaining forest stands. - Lack of policy incentives in relation to forest management to deliver climate change mitigation outcomes.	- Missing linkages in the existing policies and plans to enhance and conserve forest carbon stock. - Lack of policy incentives for promotion of SRF.
Technical	- Need to develop better know-how of the technology among the experts and institutions. - Limited data and information on silvicultural practices.	- Limited progress on R&D of the SRF technology in Nepal. - Inadequate data available on baseline situation of forest biomass.
Market support systems	- Inadequate information regarding market system.	- Inadequate information regarding market system

3.5 Enabling Framework for Overcoming the Barriers in Forestry Sector

Based on expert knowledge of the stakeholders and the picture of an enabling environment for technology, experts have discussed measures that could overcome barriers for each group of factors for each prioritized technologies. Through the discussion, the recommendations are proposed for the Forestry sub-sector. Table 13 lists the barriers and measures identified in the Forestry Sector.

Table 13: Enabling Framework in Forestry Sector

Barriers	Measures
Silviculture Technology	
- Inadequate resource allocation - More focus of the national policies on maintaining forest stands.	- Access and utilize financial resources generated from international mechanisms such as CDM and REDD+.

Barriers	Measures
- Need to develop better know-how of the technology among the experts and institutions. - Need of effective multi-stakeholder participation mechanism.	- Introduce policies to enhance forest yield and carbon sink. - Capacitate institutions at all levels to keep abreast with the recent development in technology implementation and enhance knowledge of the human resource involved. - Establish local markets to support forest based enterprises.
Short Rotation Forestry Technology	
- Inadequate investment in research and demonstration. - Missing linkages in the existing policies and plans to enhance and conserve forest carbon stock. - Inadequate knowledge and skills on raising new species and varieties - Inadequate information regarding market system.	- Promote investments from government, non-government and private sectors as well as international funds. - Adopt specific strategies addressing the issues related to SRF for enhancement and conservation of forest carbon stocks. - Conduct specific capacity building activities to increase technical capacity of relevant experts and governments in SRF technology. - Perform market feasibility survey and establish local markets to support forest entrepreneurship.

CHAPTER-4: SUMMARY AND CONCLUSIONS

Through the consultative process, this report has identified potential technological barriers and prepared Technology Action Plan for overcoming those barriers which are hindering the adoption of mitigation technologies in the Agriculture, Energy, and Forestry sectors. As mentioned in the report, there are several cross-cutting issues that exist as common barriers to the effective implementation of the technology at all levels of the technology deployment process. Since the inception of the TNA process in 2009, Nepal has achieved remarkable progress on the policy and institutional front. Now, it is high time for Nepal to roll out the mitigation targets outlined in the national policies and international commitments such as the second NDC. Therefore, in order to achieve low-carbon, inclusive and climate resilient development, Nepal desperately needs support in climate finance, capacity building, and technology development and/or transfer.

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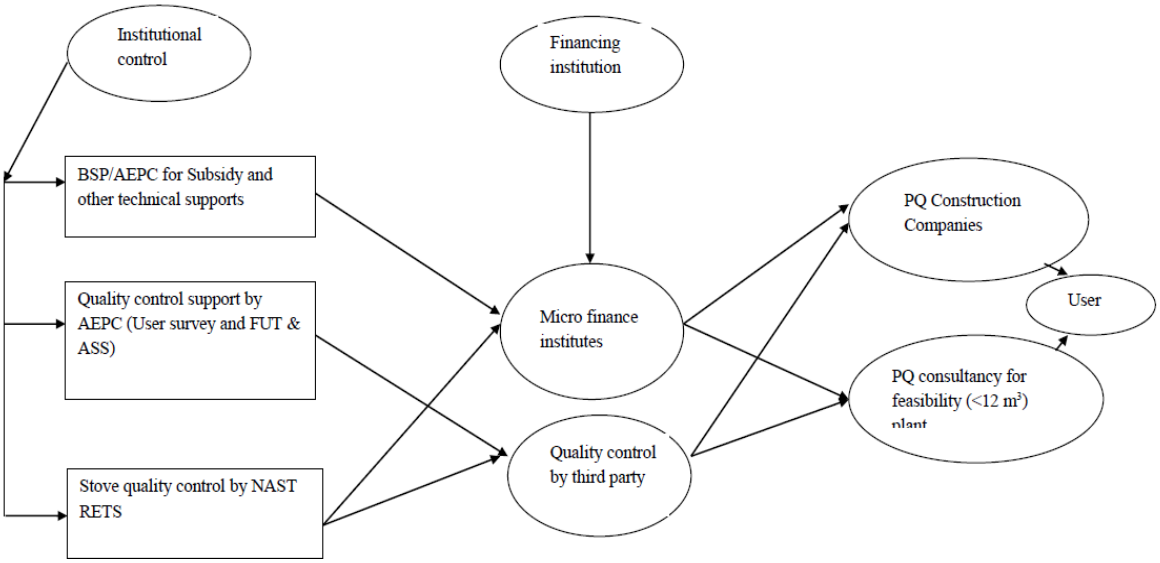
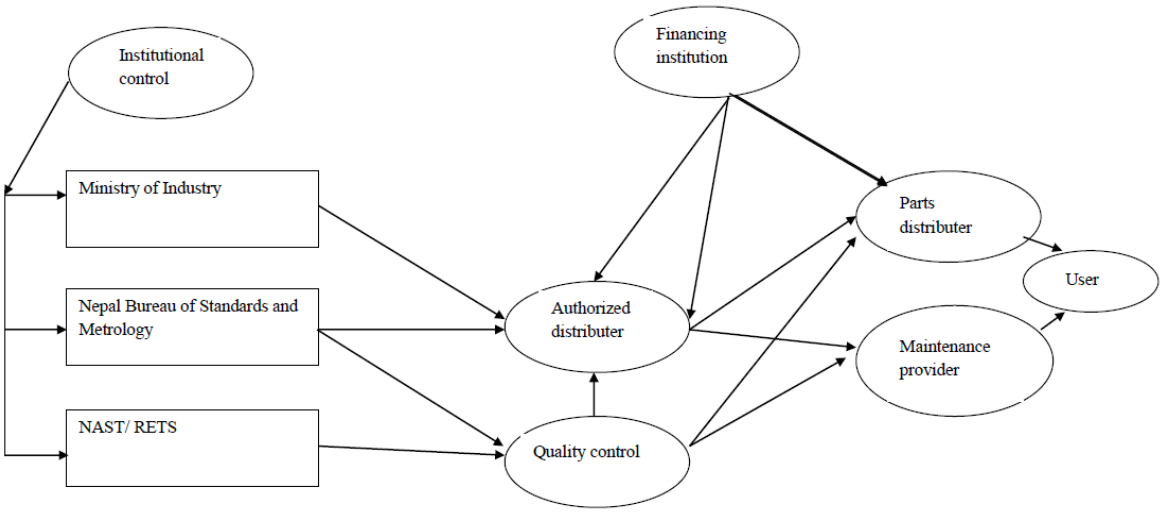
Annex 1: Market map for the Biogas Plant market chain



Annex 2: Market map for the Electric stove market chain



Annex 3: List of Participants

Meeting attendees of first consultation workshop on TNA Considering Adaptation and Mitigation Technologies

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