Proceedings of

INTERNATIONAL WORKSHOP

ON

WOMEN IN AGROFORESTRY

28-29 November 2013

Lazimpat, Kathmandu

Complied by

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About The Workshop

Agroforestry in Nepal is increasingly becoming important discipline. It is because agroforestry accommodates forestry, agriculture, livestock and other relevant discipline in a given space and time so as to raise the productivity of each component without jeoparadiazing the each components productivity. Women are mostly involved in agroforestry activities in most of developing countries yet their roles are not ackowlodge.

Therefore an attempt to look at role of women in agroforestry activities organizing a workshop .This is the first workshop in Nepal being organized by both Nepalise & other development partners.

International Union of Forest Research Organizations (IUFRO) Agroforestry Research Group 1.04.00, Ministry of Forest and Soil Conservation, government of Nepal and Nepal Foresters' Association were instrumental in organizing **'Women in Agroforestry'** workshop from 28th to 29th November, 2013. The workshop was sponsored and supported by USAID Hariyo Ban Programme, Multi-stakeholders Forestry Programme (MSFP), International Centre for Integrated Mountain Development (ICIMOD), Dabur Nepal, Shtrii Shakti (S2) and SEARCH Nepal (SN).The organizer would like to extend there sincere appreciation for their support.

Chief guest, Honorable Minister, Tek Bahadur Thapa Gharti, Minbistry of Forest and Soil Conservation inaugurated the workshop by watering a tree sapling. The workshop was chaired by Dr. Ganesh Raj Joshi, Secretary, Ministry of Forests and Soil Conservation. Welcome speech was delivered by Prof. Dr. Abhoy Kumar Das, President, Nepal Foresters' Association (NFA). Dr. Swoyambhu Man Amatya, Deputy Coordinator, Agroforestry Division, IUFRO introduced the workshop objectives and need for conducting the workshop in the country. Ms. Indira Shrestha, Former Member, National Planning Commission, Government of Nepal and Chief Executive, Shtrii Shakti, Dr. K. C. Paudel, Secretary, Water and Energy Commission Secretariat, and Mr. Jaya Mukunda Khanal, Secretary, Ministry of Agriculture and Development delivered very valuable remarks on the theme and the importance of the workshop. Vote of thanks was delivered by Mr. Kumud Shrestha, Vice President, Nepal Foresters' Association. Workshop programmee is available in annex 1.

The workshop was attended by more than 150 personnel form from various organizations including the academia, government and non-government during the inaugural session. Complete list of participants is provided in annex 2.

A total of twelve papers were presented during the workshop. More than seventy five Agroforestry experts, women agroforestry practitioners and students participated in the paper presentation on

the first day. However, there were more than fifty personnel including women participants, working in the Government and Non-Government Organizations attended the final paper presentation session.

The workshop addressed various critical issues of gender roles in agroforestry and its sustainability. Specifically, the role of women in agroforestry, for the development of both forest-based agroforestry and farm-based agroforestry system were addressed in depth including the importance of agroforestry in climate change resilience. The workshop examined ecological, economic and social benefits from the perspective of sustainability including cultural systems, equity and poverty.

A half day field visit was organized in Banepa, Kavreplanchok district to observe the mass production of various medicinal and aromatic plants seedlings produced in the nursery of Dabur Nepal.

The workshop has provided an excellent opportunity for participants to share their experiences and learn from each other. This first workshop in Nepal has opened a platform for scientists/ researchers, natural resource managers, civil society leaders, professionals, academician, and policy makers to share their research findings. The workshop has provided the space to young researchers to share cross country experiences and research findings.

The organizing committee has decided to include the paper of some author in the proceeding although they were not present at the time of workshop.The publication of the proceeding was delayed only because one full paper could not obtained on time despite several request made by the worshop secretariat. Hence, only the abstract of the paper has been included in the proceeding.

The organizing committee would like to keep on record its special thanks to all executive member of Nepal Foresters' Association and office bearers especially Mr. Shridhar Prajapati, Office Executive, of Nepal Foresters' Association. Ms. Hema Mahara, Executive Assistant, and Mr. Dhan Bahadur, office for the cooperation during and after the completion of the workshop.

Dr. Swoyambhu Man Amatya
Deputy Coordinator, Agroforestry (1.04.00) Research Group 1.

Prof. Dr. Abhoy Kumar Das
President, Nepal Foresters' Association
Babar Mahal, Kathamndu, Nepal.

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INAUGURAL SESSION

WELCOME SPEECH

Prof. Dr. Abhoy Kumar Das
President, Nepal Foresters' Association (NFA)

Respected Chairman, Secretary Ministry of forest and soil conservation, Dr. Ganesh Raj Joshi, Chief Guest, Honorable Minister for forest and soil conservation, Mr. Tek Bahadur Thapa Gharti, other special guests at the dash and all respectable guests and participants, ladies and gentlemen,

Good morning to you all. It is a nice moment for me to welcome you all at this august gathering on behalf of myself and the organizing committee. After long sequence of programming this important workshop today is going to happen and we are here to open this program by our distinguished chief guest honorable Minister of Forest and soil conservation Mr. Tek Bhadur. Thapa Gharti. Due to uncertainty of election and announced protest situation some of the participants and paper presenters could not finalize their program and lately cancelled to join at the last moment. We were also in suspect, fortunately the election accomplished peacefully and the situation is well settled by virtue allowing us to bring program in good and peaceful way. Today we are here to recognize the role of women in sustainable management of natural resources and protection of our environment.

As you know a large share of Nepalese population is forest dependent. Women's relationship in Nepal, with the environment in general and with forest resources in particular, is complex. Women in Nepal, especially of rural districts, are more inclined to household affairs such as collection of fire wood, fodder and animal bedding for livestock, and search for wild food. These household operations drag a significant amount of time available to them.

Deforestation and forest degradation is a serious concern in Nepal. This concern can be addressed to some extent by developing agroforestry practices and increasing the productivity. Agroforestry practices can provide agriculture crops, fodder, small wood, medicinal and aromatic plant on the same piece of land without sacrificing the productivity of others crops. Women are practicing agroforestry to obtain daily requirement of food, fodder and fruit products but so far their contribution has not been accounted. Additionally, literature regarding the importance of agroforestry as means of livelihood for rural women is very scanty and women's contribution generally has been overlooked. Therefore, a workshop on the theme **'Women in Agroforestry'** felt needed to be held in order to capture the current critical emerging issue of involvement of women in agroforestry.

It is anticipated that the workshop will provide insights on strategies to be adopted for strengthening roles of women in agroforestry in light of changes brought forward by the incidences

of climate change. It is expected that the workshop will provide networking opportunities as there will be representation of agroforestry experts, women agroforestry practitioners, academicians, government representatives, non-government stakeholders as well as young students. Therefore, there will be an opportunity for discussing and debating on existing theories and realities in practice. Today we are here to highlight the importance of agroforestry and bringing this valuable aspect in light.

I trust the workshop will provide an excellent opportunity for participants to share their experiences and knowledge and learn from each other. I wish successful completion of this workshop and also wish to have nice stay of the participants particularly from outside Nepal in this cheerful city of Kathmandu valley. I also wish them to have safe journey back to home. At last on behalf of the organizing committee I again welcome you all here.

Thanks to you all.

INTRODUCTION SPEECH

Dr. Swoyambhu Man Amatya
Deputy Coordinator, Agroforestry Division, IUFRO.

Mr. Chairperson,

Minister, Ministry of Forest and Soil Conservation,

Secretaries,

Ex- Secretaries,

Distinguished Participants,

Media personnel,

Ladies and Gentlemen

I am extremely delighted to be with you all today at this workshop '**Women in Agroforestry**'.

We all know that forests play a crucial role in Nepalese economy. They perform three major functions: Production, Protection and Regulations. And to perform all these functions we must at least have forests. We need big and small timber for construction, firewood for heating and cooking and other non-timber forest products for food and other medicinal and aromatic uses. But because of various reasons, our forests are vanishing rapidly and forest areas are being converted into other types of land use. However, science has developed a technique termed as "agroforestry" where we can have trees, agriculture and herbal crops, livestock on the same piece of land and at same time. Actually, agroforestry has been in practice in Nepal since time immemorial. Our farmers are practicing this technique of raising trees on terrace risers and planting agriculture and other crops in between. The technique provides ample opportunity of using the same piece of land at the same time and without sacrificing the productivity of other crops.

Agroforestry can be understood as a dynamic, ecologically sound system of natural resource management, involving the integration of trees on farms in agricultural landscape. This helps to diversify and sustain production and thereby enhancing economic, environmental and social benefits. But agroforestry is not a panacea for all the problems. This workshop, which will certainly provide a significant quantity of information on various aspects of agroforestry, will in addition raise the critical issues of gender roles in agroforestry and its sustainability, climate change and its impact on agroforestry. It will also look at the different dimensions of sustainability: ecological, economical, social and cultural, and it will throw light on equity and poverty issues as well.

Most of you, I assume, are aware of the International Union of Forest Research Organization for Research (IUFRO). IUFRO is a non-profit, non-governmental international network of forest scientists, founded in 1892, with its headquarters located in Vienna, Austria. IUFRO promotes global cooperation in forest-related research and enhances the understanding of the ecological, economic and social aspects of forests and trees. It has nine Scientific Divisions, eleven Interdisciplinary Task Forces, and two Science Policy Initiatives. The Agroforestry Research Group is under Division

one Silviculture and has specific number 1.04.00. And this workshop is being organized under this organization.

It was my dream to have such a workshop in Nepal especially because Nepalese women are enormously involved in agroforestry business in most part of the country.

It is a matter of satisfaction for me that I have been involved in this institution for a long time and that, currently, I am one of the Deputy Coordinators of the IUFRO Agroforestry Research Group. Let me express my gratitude and happiness to have organized this workshop in Nepal in collaboration with Ministry of Forests and Soil Conservation, Shtrii Shakti (S2), SEARCH Nepal (SN) and Nepal Foresters' Association (NFA). I have had this dream for a very long time, but for some reason or other I could not turn into reality sooner. This workshop could not have been organized without the generous support and cooperation of Minister, Secretary and senior key personnel of the Ministry of Forests and Soil Conservation, the entire team of Nepal Foresters' Association, Shtrii Shaktia and SEARCH Nepal. I would like to acknowledge them for their great cooperation and generous support.

To the international participants I wish to extend a warm welcome and to wish a happy stay. I hope the deliberations will be fruitful. You are the most important figures for this workshop: without your participation this workshop would not take this shape.

Finally, I thank you all for your active participation.

Remarks

Ms. Indira Shrestha
Chief Executive, Shtrii Shakti

Respected Chairperson,

Honorable Minister and Chief Guest of the event,

Secretaries, Past and Present,

Distinguished guests and Participants,

Media Persons,

Well, I would like to start paying my respect to Ester Boserup who first documented women's crucial role in development process through her research work "Women's Role in Economic Development" in 1970.

In Nepal under the influence of this information, the milestone national research study on the Status of Women in Nepal (1977-81) was undertaken for the first time and established the first scientific basis for gender planning, policies and programming as a legitimate tradition since the 6th five year plan in Nepal.

Despite the documented reality of women's important role in development process development projects continue to be designed without attention to their effect on women or of the role of women in their implementation. A study of World Bank forestry projects, for instance, found that only eight of them made specific reference to women (World Bank, 1980). Agro forestry projects are no exception to this. Women have traditionally played important roles in agricultural production and in the use and management of trees and forest products. The importance of these roles is, however, often obscured by the prevailing myths about the roles and status of women. I would like to share four of these myths about women's role and contribution in our subsistence economy.

The first myth is that women are just housewives. In reality, especially in rural Nepal, women are, in fact, farmers very often playing major role and take responsibility for food production and processing. Women have been demonstrated to play a major role in agricultural work and agricultural decision-making in Nepal. Equally animal husbandry and the feeding of larger livestock, particularly milk cows and calves are also the main responsibilities of women. Hence, agro forestry projects that involve fodder trees, the servicing of crops by trees or intercropping of crops and trees must include women, since it is they who grow the crops or care for the livestock that will be involved.

Second myth is that only men are users of and responsible for trees. In fact, women are the primary users of forestry products such as fuel wood, wild foods and fodder. The SOWN (1977-1981) found that 78% of the fuel collection in Nepal was done by women, with 84% done by women and girls combined. Men are more likely to be interested in forest products for commercial sale and in products with end-uses farther from home. Women collect fuel wood as well as food for both humans and animals from forests and individual trees. Women also use forest products for

purposes like basket-making, ropes making, straw mats and other such annual supplies for the livelihood needs.

The third myth is that every woman has a husband or is a member of a male-headed household. In fact, increasing numbers of women head their own households. Sometimes this is by choice. Other times it is the result of personal option and or events such as death of a spouse, divorce, separation, desertion or abandonment, or of social trends such as male outmigration both within and outside the village, city and the country.

For whatever the reason, women-headed households are found in substantial numbers in every region of the world. In short, the woman-headed household is an increasingly common social phenomenon. And, as a result of heading their own households, women have assumed new roles. A historical process of women undertaking "male" tasks and working in "male" sectors has been reported for a number of societies, and it is no exception in Nepal.

The fourth myth is women's are passive members within the household and society. The important influence women have in private/public domain as well as informal networks is quite strong and effective. Within the domestic sphere, women exercise influence on public events through their information links, which are based on lineage ties, and on their ability to handle sites necessary for men's public action and participation. Women's solidarity and informal groups may take a very active stance in defending their own interests.

Women, then, both individually and collectively, have private influence on public action by men and undertake public action themselves. The potential for women's public action in areas such as reforestation and soil and water conservation is especially high because they are the principal sufferers from environmental degradation. It is they who must walk farther for water, fuel wood and fodder. It is they who must produce subsistence crops on increasingly degraded soils. It is they who often are both stakeholders able and likely to have the potential to organize the community for action.

I would like to refer to a recent study done on Women's Empowerment in Public Land Agroforestry: Evidence from Central Terai, Nepal by Anil Shrestha SNV Nepal.

Women are responsible for a large share of domestic and farm chores. There has been a gradual shift in women's social status. Evidence of women's growing empowerment can be seen in their active participation in public land, agro forestry activities, which was almost non-existent in the past in terai region.

With regard to the poverty reduction goals, there has also been an improvement in the livelihoods of more than four thousand household members of the Public Land Forestry (PLF) groups. The groups are now collectively generating an additional annual averages income of 12 million in Nepali Rupees from the sale of agro forestry products. The cash income earned now goes directly to women members, enabling them to enhance their own and the wellbeing of their families. In this particular case, it has been found that women have invested a significant amount of cash income in their children's education, household food and health expenses and group savings and credits activities.

There are also many outstanding examples of major leadership positions held by women (such as secretary, treasurer and even chair-person) in the PLF groups across all levels, from the smallest village groups to district level networks and the umbrella association. Out of over 400 public land forestry (PLF) groups formed so far 110 groups are made up exclusively of women members, while 133 have mixed male and female membership and chaired by women. Among six district-level PLF networks, two districts (Bara and Parsa) have female chairpersons. In addition, out of 13 executive board committee members of the central level association, six (nearly 50% of the decision making body) are women.

Obviously, the public land agro forestry initiative has played a vital role in promoting social and economic empowerment of its beneficiaries, namely the poorest and most socially excluded community, of central terai. Women's engagement in social and development initiatives is gradually being appreciated and accepted within the Madhesi community, which should contribute to an overall improvement in their social status in the long term.

Lack of clear public policy to collect accurate data of the full economic impacts is reported. The drafting of public land Forestry Guidelines is therefore a significant move in this context. It will contribute to a significant rise in the income of male and female PLF group members. This case therefore demonstrates the importance of strategic and coordinated efforts by development agencies and public sectors organizations, such as the Department of Forests to foster gender and socially inclusive development interventions. Where else could this matter be brought up for drawing the needed attention and action than this platform decision maker to facilitate a clear legal framework of policy guideline which I understand is now in the pipeline.

Thank you for this opportunity to share my thoughts. I wish successful deliberations of the workshop.

Remarks

Mr. Jaya Mukund Khanal
Secretary, Ministry of Agricultural and Development

Respected Chairperson,

Honorable Minister, Ministry of Forests and Soil Conservation

Respected Secretaries and Ex-secretaries of Government of Nepal,

Distinguished Delegates and Participants,

Ladies and Gentlemen,

It is a great pleasure for me to be a part of this august gathering. Agriculture and forestry are two complementary sectors having significant contributions to national economy. Women are the most productive but overly burdened human resources in Nepal. The theme of the seminar "Women in Agroforestry" is a timely reminder for all of us about the role and importance of the women and the agroforestry for the holistic development of the country. The theme, I believe, integrates two very essential human and environmental dimensions for our survival.

We have learnt a great deal about the role of women to family, society and the environment. They remain close to nature and are, therefore, in better position to give direction for any scientific works in this field. I believe, science today needs to work more closely with women in identifying, designing and developing agroforestry practices. Due care must be taken to make any suggestive interventions women friendly, environment friendly, and profitable.

There are evidences that agroforestry can provide a sound ecological groundwork for productivity enhancement of agri-food products, generate more dependable economic returns, and enrich biodiversity in the Nepalese context. We have policies, institutions and science-based knowledge in place to promote agroforestry practices in Nepal. Since women are the primary beneficiaries and participant of agroforestry interventions, collaboration between government, development partners, private sector and scientific community is essential to find a realistic approach that benefits women directly through any agroforestry interventions. I believe, if we can ensure that women are benefitted physically and economically, a social and environment benefit to the community and the country will be automatically guaranteed.

In this workshop, I would like to see realistic recommendations directed to Ministry of Agricultural Development. Our ministry is very keen to work with stakeholders in forestry. I would like to reiterate that agriculture and forestry are two closely nested disciplines where rural farmers, particularly women, are common beneficiaries.

Finally, I wish for the success of this workshop. Thank you all.

Remarks

Dr. Krishna Chandra Paudel
Secretary, Water and Energy Commission Secretariat

Respected Chairperson,

Honorable Minister, Ministry of Forests and Soil Conservation,

Respected Secretaries and Ex-secretaries of Government of Nepal,

Distinguished Delegates and Participants,

Ladies and Gentlemen,

It gives me an immense pleasure to be a part of the opening ceremony of this special Workshop organized in one of the famous agroforestry countries Nepal.

At the outset, let me extend my warm welcome to all our guests, representatives from IUFRO and participants from various countries and wish you all a pleasant stay in Kathmandu.

As we all know, Agroforestry is a collective name for land use systems in which woody perennials are grown in association with herbaceous plants and/or livestock in a spatial arrangement, a rotation or both and in which there are ecological and economic interactions between the various components of the system. In fact, agroforestry is a dynamic, ecologically based, natural resource management system that diversifies and sustains small holder production for increased social, economic and environmental benefits.

Conceptually, agroforestry should be viewed as a synchronized vision by both of our eyes to agriculture and forestry. Agroforestry contributes to food and nutrient security, biodiversity conservation and maintenance of ecological functions, crop diversification and safety net, cultural and social integrity, carbon capture (climate change mitigation and adaptation), soil and moisture conservation, supply of raw-material. It serves as income and employment opportunities livelihood support, economic development for small or micro enterprises,

In the context of increasing food and environmental insecurity worldwide; agroforestry has greater role to play both as long term silvicultural and intermediate agricultural production along with maintenance of ecological integrity.

In Nepal, wood and food production in the same piece of land, together by men and women is an age old practice. Except few paddy fields down in plain areas, the whole of the mountain farming system of Nepal can be considered as one or more forms of agroforestry systems. Major agroforestry systems include trees in terrace risers and farm boundaries; fruit and fodder trees in the home gardens; silvo pastoral system; Trees with cash crops (e.g. Utis-Cardamum agroforestry) and community wood lots. Such a farming system is characterized as complex, labor intensive and low return. Farm and forestry linkages are strong. Nutrient flow from forest to farms takes place in the form of livestock feed/fodder or bedding material that significantly influence the farm productivity. Crops, livestock and trees constitute key components of our farming system. The interaction among and between these components and the human interventions determine the

productivity and sustainability of agroforestry systems. Farmers in the hills of Nepal have been growing over 200 different trees and shrubs in and around farmland which provide food, fodder, fuel, fertilizer, fiber, medicines, constructional timber, bamboos, resins, dyes, spices, vegetables along with environmental services such and soil and water conservation. Farmers also derive substantial amount of economic benefit through the collection and marketing of NTFPs from community and government managed forests. Agroforestry products such as large cardamom, cinnamon leaves, high value MAPs, wild fruits, nuts and vegetables are among the tradable products contributing to livelihoods and poverty reduction. Women play a significant role in maintaining agroforestry and deriving tangible and intangible benefits for the family and societies. They are the custodians of natural resources, traditional knowledge banks and innovators of modern technologies.

One may ask; why Nepal and many countries around the world having agroforestry are still poor ? In fact we are not poor rather potential. Because of globalization, urbanization, land use changes and need for more and more food production, agroforestry systems face several challenges. Crop intensification, commercial agriculture with modern varieties (often hybrids and GMOS), increased use of chemical fertilizer and pesticides all have adversely affected the maintenance of traditional yet ecologically stable farming systems. Hence, facing severe problems such as crop failure, loss of genetic diversity, degeneration of local land races, insect and paste outbreaks etc.

In order to minimize these threats and enhance the productivity of agroforestry land use systems, we need to consider the followings:

- Realization of agroforestry as an important land use system for social, ecological and economic benefits at all levels thereby formulate appropriate agroforestry policy, legislations and institutions.
- Engaging more of women participation in such high level dialogues.
- Identification and promotion of high value agroforestry products, value addition, farmer access to credits and markets and develop crop insurance policies.
- Capacity building of women farmers through the provision of agroforesty education, training, tools/ technologies, and empowerment.
- Revisiting the role of Agriculture and Forestry institutions (including Government Ministries and Departments) and creation of common platform for agroforestry Research and development
- Increasing investments on women friendly agroforestry technologies and enterprises, particularly product development through farmer driven and market led processes.

This workshop may wish to consider following points in your discussions and provide way forward to the organizers.

- Are there any gender specific approaches to agroforestry, particularly the women and minorities whose interests can be safeguarded ?
- Are we considering gender dimension in agroforestry research and development ?
- Are there any women specific agroforestry enterprises and whether they are given due attention and priorities in our agriculture, forestry policies and programmes ?
- How can we maintain, restore or rebuild such agroforestry that contribute to local livelihoods and sustainable future of our children ?

Ladies and Gentlemen,

The role and contribution of women in agriculture and forestry has always been appreciated, time has come to recognize and reward for such contributions. Finally, I believe that initiatives such as this workshop can further enhance our knowledge and understanding about agroforestry in general and enhance its benefits to women, poor and marginalized communities in particular. I thank IUFRO and Dr. Amatya for choosing Nepal as venue for this workshop.

I wish this workshop a grand success.

INAUGURAL SPEECH

Tek Bahadur Thapa Gharti
Honorable Minister, Ministry of Forests and Soil Conservation

Chairperson of the Session,

Government Secretaries,

Ex-secretaries Government of Nepal,

Distinguished delegates,

Media personnel,

Ladies and Gentlemen,

Good Morning and Namaste !

I am very delighted to be here with you this morning in the inaugural session of the two day workshop on 'Women in Agroforestry' being organized by the Ministry of Forests and Soil Conservation, International Union of Forest Research Organizations, Nepal Foresters' Association in collaboration with Shtrii Shakti and SEARCH.

Men and women have different roles and, therefore, will be affected differently by any intervention aimed at making agroforestry a sustainable source of people's livelihood. Particularly, women are making important contributions in this area both in resource generation and utilization. I highly regard the stability, strength and role of rural women in conserving and promoting agroforestry system.

Evidences suggest that natural resources are best utilized under the custodianship of women. This theme of 'Women in Agroforestry', I believe, is based on the same premise. Women are the prominent voice for a sustainable, eco-friendly and profitable agroforestry system. So, our efforts in agroforestry need to be directed towards making women's living easier and better.

There exists a high degree of correlation between gender equality and human development. For instance, Nepal ranks 157th of 187 countries in the 2012 UNDP Human Development Index and 102nd of 146 in the Gender Inequality Index. In each of the index, Nepal is in the bottom quartile. It suggests that a more women inclusive society is generally more stable and prosperous too.

Agroforestry is an age old practice in Nepal. Over the centuries, farmers have developed sustainable agroforestry system that produces crops, trees, livestock, fish, medicinal and aromatic plants and other related resources together. Their indigenous practices and methods have been evolved through years of refinement.

At the present level of scientific research and development in this field, I urge the scientific community to integrate science based practices with indigenous knowledge to make agroforestry

intervention appropriate to our context. I am in view that contextual innovations designed and developed in participation with real beneficiaries that are women, would be more easily accepted and adapted. Therefore, meaningful engagement of women in identifying and utilizing best practices of agroforestry is a call of the time.

As we all know that greater stress on the contribution of both agriculture and forestry sector to the economic, social and industrial development of the country began from the **Fifth Five-year Plan (1975-1980)** and the Government of Nepal have put forward various policies to promote long term management of the agricultural and forest area to ensure sustainable and inclusive development.

Agroforestry tools and techniques developed should be acceptable to farmers. They should be environmentally sound, economically feasible and easy to replicate. In this context, I am happy to note that international participants are also attending the workshop that facilitates cross-country sharing of learning and experiences. However, the role of women in agroforestry has been grossly under acknowledged. I believe, there would be fruitful interaction between practitioners, academicians and particularly women involved in this sector. I hope deliverables of this workshop will touch open these issues and bring practical recommendations.

Finally, I appreciate the hard work of the team to organize this workshop in Nepal. Especially, I would like to thank Dr. Swoyambhu Man Amatya, Deputy Coordinator of IUFRO and former Secretary of the Government of Nepal for taking this initiative on time.

I welcome you all in this beautiful city of Kathmandu, and encourage to enjoy rich culture, heritage and natural bounty of the place where once is never enough.

With best wishes for grand success of the workshop, I thank you all.

Vote of Thanks

Kumud Shrestha
Vice President, Nepal Foresters' Association

First of all I would like to thank Mr. Tek Bahadur Thapa Gharti, Honorable Minister for Ministry of Forests and Soil Conservation for taking the role of chief guest and providing valuable insights in relation to women and agroforestry.

I would like to thank Dr. Krishna Chandra Paudel, Secretary, Water and Energy Commission for his elaboration in need of agroforestry in Nepal and highlighting role of women in agroforestry.

I would like to thank Dr. Ganesh Raj Joshi, Secretary Ministry of Forests and Soil Conservation for chairing the inaugural functions and supporting the workshop by providing necessary supports and also delivering chair person remarks, where Dr. Joshi highlighted the role of women in agroforestry. Without the support of Ministry of Forests and Soil Conservation, the workshop would have never been convened.

I would also like to thank Mr. Jay Mukunda Khanal, Secretary, Ministry of Agriculture and Development for his speech, where he expressed insights in linking women and agro forestry in Nepal.

I would also like to thank Ms Indira Shrestha, chair-person of Shtrii Shakti for her speech in which she presented very meaningful data in involvement of women in forestry and other household purposes.

I would like to express my deep gratitude to Dr. Abhoy Kumar Das, Chairperson, NFA for his speech which described need of role of women in agroforestry in context to rural Nepal.

I would also like to thank main architect behind the workshop, Dr. Swoyambhu Man Amatya, IUFRO representative for Nepal and chair-person Search Nepal, for taking all responsibility to plan and conduct the workshop without whom, the visioning of the workshop would not be possible.

I would also like to thank Chief of the Divisions in the Ministry of Forest and Soil Conservation, Dr. Annapurnananda Das, Chief Foreign Aid Coordination Division, Mr. Krishana Prasad Acharya, Chief Planning Division, Mr. Bharat Prasad Pudasaini, Chief Monitoring and Evaluation Division, Mr. Mukunda Prakash Ghimire, chief Administration Division.

I would also like to thank Director Generals who participated in the inaugural session of the workshops. I thank Mr. Yam Bahadur Thapa, Director General, Department of Plant Resources, Mr. Bishwa Nath Oli, Director General, Department of Forests, Mr. Megh Bahadur Pandey, Director General, Department of National Parks and Wild Life Conservation, and Mr. Pem Kandel, Director General, Department of Soil Conservation and Watershed Management.

I would also like to thank division chiefs of the departments, Mr. Gauri Shankar Timiala, Deputy Director General, Department of Forest, Mr. Resham Bahadur Dangi, Chief REDD Cell and Chief,

Community Forest Division, Department of Forest, Mr. Ramesh Shakya and Mr. Hasta Bahadur Thapa, Department of Forest Research and Survey.

I would also like to thank financial supporters of the workshop Multi-stakeholders Forestry Programme and chief of its technical support unit Mr. Ramu Subedi, Ms Judy, chief of the party, Hariyoban Programme, WWF.

I would also like to thank Ms. Madhu Ghimire for supporting the workshop by welcoming all participants and taking the role of Master of Ceremony I would also like to thank all participants, ladies and gentlemen, who made the workshop a roaring success by showing their active presence. Last but not the least, I would like to thank Nepal Foresters' Association staff Mr. Sridhar Prajapati, Ms Hema Mahara, Ms Jaya Tripathi and Mr. Dhan Bahadur for their weeks of time provided to manage office works in relation to the workshop.

Speech of the chairperson

Dr. Ganesh Raj Joshi

Secretary, Ministry of Forests and Soil Conservation

Chief Guest, Honorable Minister for Forests and Soil Conservation

Researchers, Experts,

Distinguished Participants,

Colleagues,

Ladies and Gentlemen,

First of all, I would like to thank the organizer for giving me this opportunity to chair the inaugural session of this very important workshop on 'Women in Agroforestry'.

We all know large groups of people in the developing world depend on agriculture and forestry for their livelihood and these sectors also contribute to local and national economy to a viable extent. However, poverty is also prevalent in the developing world, where women and children are the main victims of poverty. In this context, agroforestry is considered a major system that helps to reduce poverty.

In the developing world, 60-80% of the farmers are the women. Women subsistence farmers also account for over 50% of total female employment in low income countries. Rural women in developing countries grow and harvest most of the staple crops and collect fodder and fuel wood required for them. They are equally involved in processing and marketing of some of the agroforestry products. However, much more needs to be done to understand the kinds of traditional and non-traditional agroforestry products that are accessible to women, and to get research attention focused on them.

In the above context, the workshop is very timely. I believe this workshop will address various critical issues of gender roles in agroforestry and their sustainability. I am sure the papers to be presented by scholars, scientists and researchers.are focused on women in agroforestry, agroforestry system, and climate change impacts on agroforestry, various dimensions of sustainability and distributional consequences of technological interventions. I believe rigorous methodologies and approaches have been adapted to research on the issues in order to come up with results that have policy implications. The results from this workshop will be useful for formulating policies and strengthening institutions and infrastructures so as to mainstream gender issues for agroforestry promotion. The Ministry of Forests and Soil Conservation will make every effort to internalize findings/recommendations in policy and programs.

I would like to thank IUFRO for organizing this workshop in Nepal and congratulate Dr. Amatya and his team for his untiring efforts to organize this workshop. I wish the grand success of this workshop.

Thank you.

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Workshop: The Role of Women in Agro-forestry, Kathmandu, 28-29 November 2013

Nepal is dependent on the agricultural sector for much of its food. It is also highly dependent on forests for natural resources like firewood and water, and ecosystem services that reduce the risk of disasters. At the same time, major changes are occurring: climate change impacts are affecting many sectors including agriculture, forests and water resources. In social terms, large-scale male outmigration from rural areas has greatly increased the proportion of female headed households in the last decade, leaving women with increased responsibilities not only in the home but also for managing farms and natural resources, and coping with the impacts of climate change. All these moving parts are inter-related, and they have a natural convergence in agroforestry.

On many farms from the mountains to the Terai agroforestry plays an important role – producing food, cash crops, fodder, fuel wood, and medicines on the same land – and strengthening household food security and incomes. Agroforestry often reduces dependency of communities on forest resources, thereby reducing unsustainable pressure and contributing to healthier forests. It can enhance resilience to climate change by diversifying livelihood options, and facilitate adaptation of production systems to changing climate conditions. But women's roles and challenges in agroforestry are not often raised in national academic and policy circles, even though they carry such large responsibilities for it.

Hence this workshop on "The role of women in agro-forestry", organized jointly by the Ministry of Forests and Soil Conservation, the International Union of Forest Research Organizations (IUFRO) and the Nepal Foresters' Association (NFA), is very timely for strengthening the engagement of women in climate smart agro-forestry. It has covered opportunities and challenges, identifying areas of capacity building for women and other stakeholders to strengthen their knowledge base, and networks for promoting agroforestry in relation to climate change. It has opened up avenues for joint initiatives and collaboration across sectors and countries of the region. It has also covered innovative fields such as carbon sequestration in agro-forestry, and opportunities to link the private sector with marginalized communities practicing agro-forestry, as well as the ever-important mainstreaming of gender and social inclusion. We hope that these insights will provide impetus for trying out new and climate-adaptive agroforestry approaches as well as scaling up proven ones.

The Hariyo Ban Program, a consortium of World Wildlife Fund, CARE, the Federation of Community Forest Users Nepal and the National Trust for Nature Conservation, funded by the US Agency for International Development, congratulates the organizers on a successful workshop. We are proud to have provided co-funding for it through the Nepal Foresters' Association. We believe that this initiative is a real milestone in enhancing women's roles in climate-smart agroforestry in Nepal and the region.

Judy Oglethorpe

Judy Oglethorpe, Chief of Party, Hariyo Ban Program

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PAPER PRESENTATION

Prospects of agroforestry practices in Nepal with an emphasis on women's perspective

Dr. Keshar Man Bajracharya
Member Academician, NAST

Agroforestry is a science in itself even though it has not been able to command much of attention from the science and technology community nor from the administrative and business agencies. If you examine carefully, it is more complex than agriculture or forestry mainly due to the combined interaction of both sciences in addition to many other aspects of natural and social environment. As all of us know, agriculture is a complex science dealing with many aspects of agronomy, climatology and meteorology, soil science, rural sociology and economics. In less developed countries, agriculture is often the backbone of development economics as well as economic modernization. To a great extent, forestry science and technology also depends upon many physical, biological and Earth sciences. Forestry also contributes significantly to ecological and environmental stability without which socioeconomic infrastructures and rural development cannot be sustained. In this way, agroforestry is an important and complex field in itself.

I see a considerable prospect of adopting agroforestry practices in Nepal where one or may models of agroforestry can be applied. The main conditions of its application are as follows:

- Population pressure is out-stripping cultivable land as well as agricultural production.
- Forest lands are encroached, destroyed or degraded for extended cultivation and settlement.
- Environmental damages such as air pollution, loss of biodiversity, climate change (due to natural and man-made disasters), soil erosion, increasing emission of greenhouse gases are imminent.
- The country is vulnerable to severe landslides, floods during the rainy season, and drought/ desiccation during the dry season.
- Water for drinking, animal husbandry and irrigation is becoming scarce.
- There is a strong possibility or necessity of growing high value horticultural crops, non-timber forest products, and medicinal herbs for export with or without processing.
- Women are not able to play a significant role in socio-economic development due to low educational level and/or lack of encouragement.
- The socio-economy is based more on agricultural sector instead of industry and services
- Unemployment and under-employment are widespread.

Nepal is suffering from most of the above woes even though there are opportunities for resolving them with support from government agencies, non-government organizations and private businesses. If these supports become available it will be possible to make agroforestry successful

in Nepal. In this respect, Nepalese women who are already working in all aspects of agriculture, forestry, animal husbandry, health and sanitation, child-raising, etc., will also be able to contribute significantly to rural development through appropriate agroforestry practices in all geographical regions of the country.

I will now briefly present firstly, the natural and environmental situation of Nepal, and secondly, on the prospective role of women in agroforestry.

We are told by paleo-geologists that the Himalaya began to rise when the Indian Subcontinent after separating from the Gwondawana land, drifted towards the north and sub ducted under the Eurasian plate some 35-40 million years ago thereby annihilating the Mesozoic Sea of Tethys, the remnants of which is the Mediterranean Sea. Since then, a series of other ranges including the High Mountains of the outer Himalaya, Mahabharat, and Mid-land valleys were raised. The last range, the Siwaliks, also called Chure Range in Nepal, was raised up only 11 million years ago out of the former deposits of sandstone, conglomerates, silt and clay laid down by the erosive processes in the higher ranges. Further erosion of the Siwalik Range by colluvial and fluvial processes resulted in the Bhabar tract in the foothills of the Siwaliks and the alluvial Terai plains further south, which form the northern edges of the Gangetic plains. Occupying a little more than the central third of the Himalayan Range from Hindu-Kush in the west to Namkin Mountains in the east, Nepal developed a variety of physiographic as well as climatic features.

A very brief account of physiographic sections of Nepal across the Himalaya is in order now. Starting from the south, the alluvial Terai plains, which is located at below 200 meters above mean sea-level is the main granary of Nepal. As a result, most of this region is cultivated, but the agricultural productivity is stagnating. The Bhabar tract, also known as Char Kose (Four Mile) Jhadi, at 200-300 masl is only sparsely settled and there still exists some forests most of which are degraded. However, this tract is particularly suitable for wildlife habitat. It has a highly infiltrated dry shallow soil over a thick layer of colluvial gravel, stone and sand. Standing at 1200-1500 masl, the Siwalik Hills are very vulnerable to erosion and land degradation. Between the Siwaliks and Mahabharat range, there are a number of east-west elongated valleys called Doons, such as Rapti Doon (Citwan), Dang, and so on. They range in elevation from about 300-400 meters. These valleys are somewhat similar to the Terai plains for agricultural production.

The Mahabharat Range (about 2000-3000 m elevation) is vulnerable to landslides and erosion. The Midland region on the north side of Mahabharat, which is elevated at about 1000-2000 m, is somewhat narrow in eastern Nepal and wide in the western side but quite densely populated. Most of the districts in this region, like Dhankuta, Dolakha, Kavre, Kathmandu Valley (three districts of Kathmandu, Bhaktapur and Lalitpur) in the east, and, Nuwakot, Pokhara, Palpa, Doti, Dadeldhura in the west have most salubrious climate.

In the High Mountains and High Himal Regions, the population is scarce and some forest types of pine, fir, spruce together with some valuable broadleaf species of Quercus, Rhododendron, Acer, as well as some very high value medicinal plants still exist. In addition, there is also a good potential to tap highly prized animal products like musk, yak and goat wools, and many kinds of wild birds and wildlife. In addition, there are also a number of edible mushrooms and Yarsha Gomba, which is a fungus growing over an insect larva.

There are some parts of Manag and Mustang districts, which are situated north of the main Himalayan Range (trans-Himalayan) and hence have very dry climatic conditions as in Tibet. These districts have some potentiality for Yak and sheep husbandry as well as for horticulture and forest trees like Poplar, Salix, etc.

These regions together with snowmountains and glaciers are the main sources of perennial river systems of Koshi, Gandaki, and Karnali. Obviously these river basins have a large potentiality for hydroelectric power generation and irrigation.

The overall climate of Nepal falls in the sub-humid monsoon category, which receives about 2000 mm of rainfall annually in the eastern part, about 1500 mm in the central part and only about 1000 mm in the west. Nearly 80-90 percent of the annual rainfall occurs during the southwest monsoon period, which brings rain clouds from the Arabian Sea as well as the Bay of Bengal, during the summer months of June through September. The northwest monsoon during the winter, coming from the Mediterranean Sea contributes only 10-15 percent of the annual rainfall with precipitation being mainly in the form of snow in the western mountains.

Now is the turn to describe the people of Nepal with special reference to women. The population of Nepal is also approaching 30 million, of which women constitute nearly 51 percent. Most of the elderly women do not have formal education, but are highly knowledgeable in agriculture, forestry and animal husbandry practices as handed down through the generations. The rural women work very hard, usually two times more than the men folk. Moreover, they are trust-worthy and do not have bad habits of any kind. The younger women and girls are now attending schools and colleges more actively than the boys, but are still not fully incorporated into the work force. In almost all the rural areas women are now actively participating in community and lease-hold forestry practices too.

We must remember that livestock rearing is an important activity of women in all the geographical regions of Nepal. In recent years, the dairy industry for milk products, poultry, wool for pashmina, pond fisheries, growing of fruits and vegetables and other rural industries are expanding, with a majority contribution from women. In this respect, all the ethnic groups of Nepal including, Brahmin, Chhetri, Newar, Tamang, Rai, Limbu, Sherpa, etc., have an active and hard-working women's population in all the geographical regions.

From all the above considerations, I would like to conclude that many models of agroforestry practices with special emphasis on women's role can be developed in Nepal. I would like to only mention a few examples as follows:

- The Terai plains, which is already cultivated, can still accommodate agroforestry practices including agri-silvi-pastoral models with north-south belts of trees with wide gaps of 10-15 meters for crop cultivation covering up to only about10% of the land by the tree crop. Such belts or rows of trees and shrubs will not create permanent shade to cultivated crops, but will also act as a wind-break and shelter belt during the dry season enhancing thereby soil moisture retention in the agricultural crops on one hand, and preventing dust blowing on the other. Such a practice of agroforestry and agricultural crop cultivation would improve crop productivity as well as provide additional benefits of timber, fuel wood and fodder besides improving rural health.

- In the Bhabar tract there is a need to improve the degraded forests through timber stand improvement of the existing forests and enrichment planting of high value local tree species in a north-south line with such land being spaced at 15-20 meters lines in apart. Where there is a gap in the forest, broadcast sowing of maize could be grown for consumption by wildlife.

- Siwaliks there is a necessity of growing some kind of soil-holding shrubs and grasses to reduce erosion in addition to enhancing of rain water. However, the northern side of Siwalik hills which constitutes a geological dip and mild slopes and deep soils has already some high value tree crops. But these can be further enhanced through agroforestry practices with contour planting of trees, shrubs and grasses for conserving adequate soil moisture to reduce fire risks during the dry season.

- The larger Doon valleys, which are more or less similar to Terai plains, will be suitable to the Terai models of agroforestry and agri-slivi-pastoral systems.

- In the Mahabharat Range, both the south and north slopes, would be best benefitted by conservation through agroforestry practices with tree and shrub plantation along the contours according the needs of the local people.

- The Midland valleys, as already mentioned, are densely populated, but have good potential for agroforestry practices with special emphasis on water conservation. Here there is a need to adopt agroforestry style watershed management practices so that greater proportion of rain water could be harvested for direct consumption of people and domestic animals as well as for recharge of groundwater. This could be integrated with community and lease-hold forest user groups of women as well as poor and deprived people so that they are able to generate income and economic power for themselves.

- In the High Mountains and High Himal regions models of agroforestry should be practiced with some planting of local tree species and high value medicinal plants for local need as well as for hiking, trekking and mountain climbing which attracts tourists from all over the world for the scenic beauty and cultural diversity.

Last but not least, research and development in all models of agroforestry practices must be carried out along with the present developments of agriculture and forestry in Nepal. My own plea is that the government and business agencies must allocate a minimum of 5 percent of their budget and human resources for R & D in these models in combination with on-going activities. There more important areas of action research in all the regions of Nepal should include:

- Selection of tree species from among some three dozen indigenous and one-dozen successful exotics vis-à-vis their silvicultural characteristics and local suitability;

- Choice of shrubs and herbs of economic value for commercial and general purposes, such as, medicine, essential oil, fibres, floss, food, etc.;

- Planting out of two-dozen known fodder trees and grasses according local preferences;

- Adoption of proven cereals, fruits, and crops;

- Development of soil and water conservation techniques to suit slow soil, aspect, and microclimatic conditions;
- Generation of additional income and employment opportunities through agri-slivi-pastoral systems.

The above R&D approaches should be introduced in all the 75 districts where the Depart of Agriculture, Department of Forestry, and Department of Soil Conservation are operating. However, planning, monitoring and operational back-stopping support should be provided by: a central agency, which is coordinated by a representative of all the concerned ministries and departments plus the Nepal Agricultureal Research Council (NARC) and Nepal Academy of Science and Technology (NAST). A team of multidisciplinary members under this agency should operationalize the above agroforestry approaches in all the districts.

If we continue such a practice for five to ten years, that too in close collaboration with the rural people, it will no doubt give us many models of appropriate agri-slivi-pasotral systems in all regions of Nepal. This would enhance agriculture, forestry, and animal husbandry, along with rural development and women empowerment. Such a result will catalyze not only the natural resources sector, but also small and medium scale industries in all the districts triggering overall economic development and modernization of Nepal.

UNLEASHING DEVELOPMENT POTENTIAL BY PROMOTING COMMUNITY SERVICE PROVIDERS IN DEMANDLED AGROFORESTRY SERVICE PROVISION

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Abstract

Bangladesh is a densely populated country where agriculture is the backbone of its economy. Despite the reality that 80% of people live in rural areas and their livelihoods are linked with agriculture, the poor are excluded from the mainstream agricultural service network. Due to poorly developed service infrastructure in Bangladesh, farmers in general, poor and extreme poor in specific are deprived from the access to the required quality services with affordable cost within their proximity. Considering the service access hurdles (e.g. the lack of resources of line agencies, unsustainable NGO services, passive private sector), and the potential of the local resources and dynamism, as an innovative approach community service provision was introduced, tested and established in north-western Bangladesh by a SLU (Sustainable Land Use) project of SDC (Swiss Agency for Development and Cooperation) managed by Intercooperation – Bangladesh. Promoting private local service provision in the rural Bangladesh, specifically in agroforestry sector was facing huge challenges initially, but found effective in terms of availability and affordability. Promoting Local Service Provider (LSP) within the proximity of community people in different domains linked directly with their livelihoods (e.g. – management of livestock, fisheries, vegetable, fruit trees, field crop etc.) ignites the process of knowledge management in rural areas, thus creates the avenue for additional income of poor and extreme poor, especially for the women. The study was conducted for the capitalisation of project experience on service provision through using a number of tools like SI, FGD, LSP database, joint review, case study etc. The study critically reviewed the trend, outcome and economics of the promoting service provision at local level. Emerging of LSPs in the community created two-fold benefits in the rural economy – ensure easy access to demanded knowledge and services at local level even by the poor and extreme poor in one hand, generate self-employment opportunities for the LSPs themselves on the other hand – which is important for the sustainability of any agroforestry system.

Key words: *Service provision, agroforestry service, poor & extreme poor, income for women, knowledge management, self-employment*

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Introduction

Background/Rationale

Bangladesh is one of the most densely populated countries in the world and around 80% of its 130 million people live in rural areas. There are about 1100 people per square kilometer live in Bangladesh (BBS, 2011). With this population level, per capita cultivated land is less than 0.08 ha and it was estimated that more than 60 million of people are functionally landless – possessing less than 0.2 ha of land (Ali, 1991). This pressure on available resources is one of the key factors of the declining poverty. On the other hand, World Bank (2013) recently stated with their *Bangladesh Development Update* report that increasing employment opportunities and raising the returns to labor is therefore the most direct way of meeting the livelihood requirements. However, simply having access to employment is not enough to lift poor households out of poverty.

Bangladesh is neither rich in natural resources nor financially endowed so as to adequately provide for its rapidly expanding population. However, the gap between actual demand and supply of basic goods is large and steadily widening. In meeting these it lays the fact that the country's population continuous to grow with it the demands for goods and services. On the other hand, the land, which constitutes the basic sources of resources, remains constant and can neither be moved nor expanded to accommodate human needs and preferences (Ali, 1991). However, Bangladesh has made great strides in improving the lives of its people since gaining independence in 1971 (World Bank, 2011). Poverty itself is a complex and multidimensional context where Bangladesh is not beyond this truth. Of the poor, women are particularly vulnerable – having the worst access to resources. About 50% of the population is considered poor and 20% are extreme poor. The bottom 40% of rural households in 1994 received only 16% of the rural income, which the top 10% owned 32% (SDC, 2002).

Agriculture is the backbone of Bangladesh economy. Despite the reality more than half of the people are poor and extreme poor, 80% of people live in rural areas and their livelihoods are linked with agroforestry, the poor are excluded from the mainstream agroforestry service network. Due to poorly developed service infrastructure in Bangladesh, farmers in general, poor and extreme poor in specific are deprived to access to the required quality services with affordable cost within their proximity. There is an enormous hurdle in accessing the existing required services due to a number of reasons, like public line agencies are facing lack of resources, manpower as well as mind-set of the chair, NGO services are unsustainable as it is mostly external fund driven which is also valid for different projects, and lastly passiveness of private sector who are confined with their product driven services. Moreover, availability of services in the local proximity is critical to enjoy the services. GFRAS (2012) argued that since the early 1990s, the nature of agriculture began to change rapidly. Though agricultural production and productivity have generally increased, poverty (including nutritional insecurity) is widespread in many of the less-favoured agricultural regions. They also added to meet the new challenges Extension and Advisory Services need to tackle a diversity of objectives that include, but go well beyond, transferring new technologies. This encompasses the need to: link more effectively and responsively to domestic and international markets where globalization is increasingly competitive; reduce the vulnerability and enhance the voice and empowerment of the rural poor promote environmental conservation8; couple technology transfer with other services relating to credit, input and output markets and enhance the capacity development role that includes training but also strengthening innovation processes, building

linkages between farmers and other agencies, and institutional and organisational development to support the bargaining position of farmers.

However, there is the potential of the local resources and dynamism which could be tuned to meet the people's demand. Intercooperation – Bangladesh under Sustainable Land Use programme (SLUP) of SDC tried to promote networks of local advisory service providers. Promoting private service provision in the rural Bangladesh, specifically in agroforestry sector was facing huge challenges especially by a process facilitating project and its partner NGOs. Developing Local Service Provider (LSP) within the proximity of community people in different agroforestry domains linked directly with their livelihoods (e.g. – management of livestock, fisheries, vegetable, fruit trees, field crop, medicinal plant management etc.) ignites the process of knowledge management in rural areas, thus creates the avenue for additional income of poor and extreme poor.

Promotion of service provision was envisaged in agroforestry as a potential mean to make an easy access to the required services by the poor and extreme poor. The study was carried out to take insight of the ground-in experiences on service provision of the consecutive phases that could steer to scale up and replicate in other areas. Testing and consolidating the ideas generated in the field the total programme was proceded. In the pave of time a concrete experiences added in the organizational repository. In order to have a comprehensive and solid experience on local service provision, this capitalisation exercise had tried to capture the innovations, trend and potential to cater the future challenges in service provision.

Objectives of the study

This exercise was done mainly for facilitating the external review mission with facts, figures and trends covering both qualitative and quantitative information regarding the service provision activities. However, through this exercise it was tried -

- to capture the status-co and trend in the evolution process of service provision
- to capture the learning points, thrust and challenges for the sustainability of service provision

Evolution of Service provision:

Vision/hypothesis of service provision

Considering the limited access to technical services for poor producers, the concept of local service provision was introduced by Intercooperation in the North-West Bangladesh under the new SLUP of SDC in 2004. The main idea was promoting a local private service provision that would facilitate poor people to have access to the demand-led quality and affordable services at their own communities through local resource persons who are tuned with advanced skills and knowledge. And these local service providers would be paid for their services which would drive towards a sustainable quality service provision at the end.

For a fee based commercial service provision the primary hypothesis was drawn on the basis of a field appraisal -

From Demand side – community people will even pay for the services if -

- It resolves their immediate problem
- It creates additional income or increase profit margin
- Readily cash information – creates new income opportunities

From supply side – progressive people will be evolved as local service provider if -

- There is a sustainable demand of services
- It contributes in their livelihoods
- Scope of having updated knowledge regularly

During the 1st phase of three years project the primary hypothesis on the potential of local service provision was confirmed, which led the 2nd phase to think of consolidating and institutionalization of the concept. In order to address such a three tier approach was drawn. Hence, the focus for the 2nd phase of the project triggered to the sustainability of the system, re-defining the role of different actors at different level, promoting self-propelling organizational model, service outreach and capacity of the LSPs in terms quality of services, specialization and diversity of services, incorporating private sectors and alignment with value chain, MSE development etc.

Deployment of Three Tier Approach

For the sustainability of local private service provision as a whole and considering the present context, service structure and the limitations of LSPs, it was envisaged the service provision concept more in institutionalized form through a 3-tier approach and tried to organize the service provision activities accordingly

1. The first tier is consisted of Local Service Providers (LSPs) and their networks or associations (e.g. – Service Provider Association - SPA), i.e. immediate service providers to meet the demand of community people and all the activities related to promote/ sustain these service providers considered as the interventions of first tier. Basically Upazilla (sub-district) boundary was thought as the provisional outreach for the first tier. However, different dynamics were observed regarding this, for instance emergence of Service Centres by a group LSPs in a public place, which have been illustrated in following sections (Section 3.1, 3.2 etc.).

2. The second tier is constituted by a Regional Resource Pool (RRP) mainly consisting of line agency experts, who would help to strengthen the capacities of LSPs and their associations. The informal nature of platform RRP had been considering very critical for the service quality at downstream. In addition to capacity building activities including

specialization, diversification, refresher, Training Needs Assessment (TNA) etc. of LSP and SPA, they were assigned for monitoring the LSPs' activities in the field. There were number of initiatives for the capacity building of RRP members also. Whatsoever the experiences are denoted in the section 3.3.

3. The national research institutions and extension agencies constitute the third tier. Basically they backstopping to the demands of field through generating and disseminating knowledge, technologies and information as well contribute to the capacity development of regional resources. In case of national stakeholders this time service purchase mood was adopted especially for research institutes. Less focus was given for their institutional capacity building. Revitalisation of NAWG (National Agroforestry Working Group) and other coordinating platforms at different level through National mandatory institutes, but ultimately didn't give encouraging result.

Process followed

Strengthening LSPs down the line was prime focus – gradually more focus was given towards diversification of their capacity, specialisation for more competitiveness, increase the outreach coverage, establishing functional linkage with more clients, CBO/CP, MSE, SPA, input companies etc. In case of SPA more thrust was given for developing organisational capacity, enhancing HID skill on organising the demands for LSPs, establishing functional linkage with line agencies, different input companies to ensure quality inputs, representation of SPA in different forum, fair etc., creating service market through demonstration, involving in monitoring the service quality of LSPs in the field etc. In case of RRP – project facilitation was for more responsiveness to the demand of LSPs, capacity building of LSPs through training, refresher, visit etc., monitoring the service quality of RRP members as well as LSPs in the field etc. A considerable effort was given to facilitate different coordinating platform for making them functional so that knowledge flow accelerated both way.

Nevertheless, this paper will be confined with the observations and findings on the performance, trend and innovation of LSPs only.

Observations, Findings and discussion:

LSP (Local Service Provider)

Selection and Number of LSP:

Selection of LSP has been going on following the set criteria, sellable outreach etc. for LSPs and as per demand of the community. Project was struggling to settle down the exact number of LSPs who were

Table 1: Information of LSP and SPA by domain at a glance

	Domain		Total
1	Livestock management		1048
2	Vegetable production & Spices		1362
3	Fruit Tree management		808
4	Field Crops management		588
5	Fisheries management		309
6	Timber & Bamboo management		214
7	Traditional Birth Attendance (TBA)		462
8	Market Extension (ME) including IGA		287
9	Medicinal Plant		101
10	Others		81
		Grand Total	5260
	SPA	No. of SPA	53
		No of Service Centre	124

identified and brought under the umbrella of service provision activities. After subsequent exercises and deploying simpler database finally at the end of 2008 a total of about 5,260 LSPs had been recognised. They were provided training and accompaniment support to improve their knowledge and skills. However, among these LSPs about 3000 LSPs could evolve as professional who could sell services with payment.

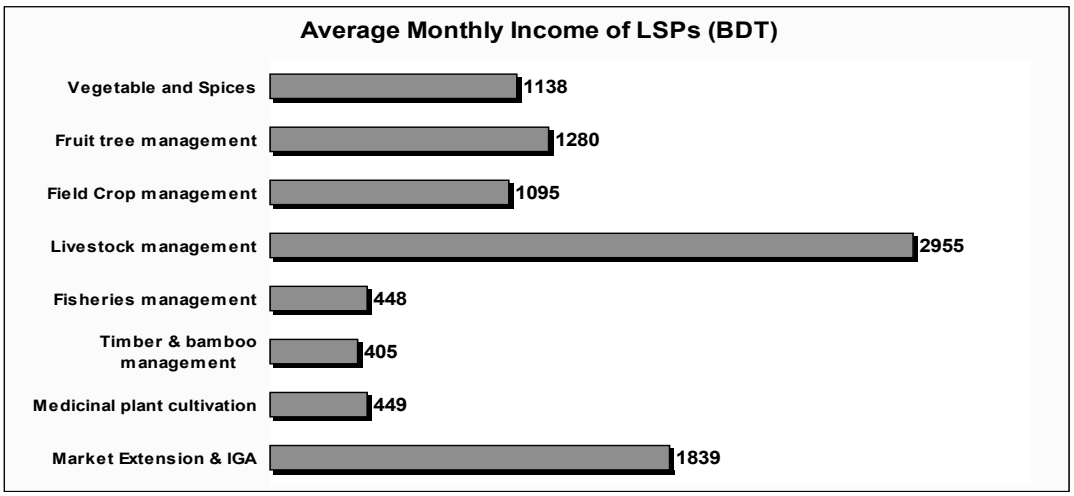
It is evident that a number of LSPs dropped out in the meantime. By revisiting and analysing the situation project tried to explore the root causes for abandoning the profession by LSPs Some of the reasons are as follows - improper selection of LSP, dropped out due to migration, change of profession, death, felt less confident by LSPs, number of FM were included as LSP in some places, initially identified but not trained or continued later on, failed to trace-out or follow-up due to frequent change of respective NGO staff etc. One general conclusion can be drawn with considering the residual impact of last 5 years on service provision - 65% of service providers could be retained in such process.

Professional LSPs are regularly selling advisory and embedded services to the communities. It was found that a significant number of LSPs could not be developed as professional LSPs because the CBOs selected the progressive farmers from their communities in order to develop them as LSPs. But the commercial attitudes of all progressive farmers could not be ascertained properly during their selection. Some of them selected by the community preferred to provide services for free - as a social work, and also because it is a marginal activity for some of them. As a result

some of the primarily selected LSPs could not be developed as commercial LSPs. Furthermore, the service markets of some domains like medicinal plants, bamboo and timber tree management etc. were not very much supportive to develop commercial LSPs. Service selling and income earning opportunities was found critical to be evolved as professional LSP. Promotion of service markets of these domains through expansion of MSEs and value chain activities could give more focus to improve the situation. It was observed that across the regions the women's involvement in private service provision was 23% in the year 2008, which was 9% more than that of 2007. Women's involvement was mainly increased in commercial service provision particularly in the domains of Traditional Birth Assistant (TBA), and poultry as well as livestock management.

Service domain and income:

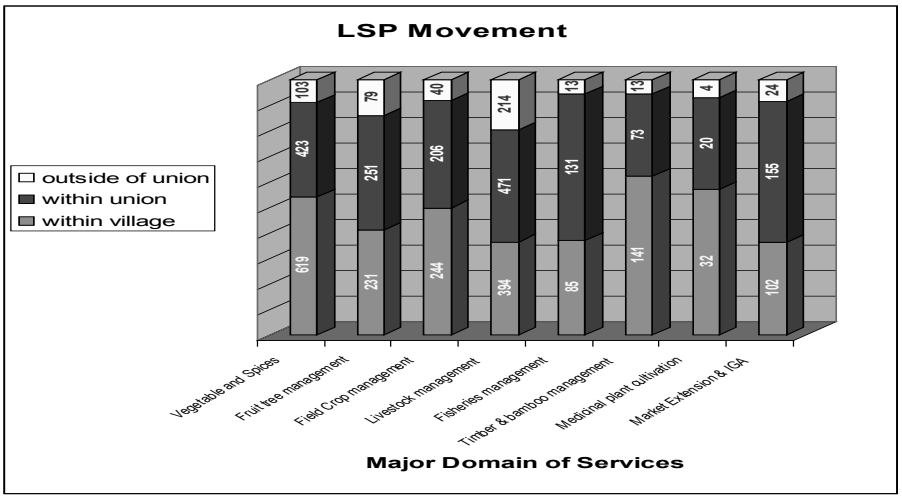
There are eight major domains of services visible in the field. In addition to that some specific domain was maintained regionally considering the regional context (e.g. TBA in Sunamganj) and specific value chain (e.g. – Medplant value chain in Bogra). Moreover, regarding off-farm and non-farm activities different types of LSPs were found in the field, e.g. Tailoring, Apiculture, Sewing master, Candle making, handicraft designer etc. However, Major domains of LSPs for the reporting period were vegetables and spices cultivation, fruit tree management, field crop management, livestock and poultry rearing, medicinal plant cultivation, fish culture, bamboo and timber tree management, non-farm IGA, marketing extension and others. A total of 3,400 LSPs received between 1 to 5 trainings from national institutions and private sector to improve and update their technical knowledge and skills. The monitoring data through specific exercise showed that the average income of each professional LSP per month was 1,500 Taka, Highest income was possible by the Livestock LSPs as they have more coverage, clients, diversified services, and who made the service provision as main activity (e.g. LSP in livestock). On the other hand these LSPs have generated additional incomes through service provision, but also have incomes from their main activities as producers.

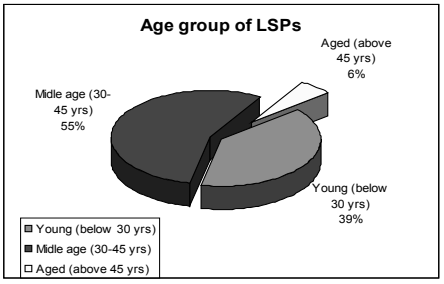


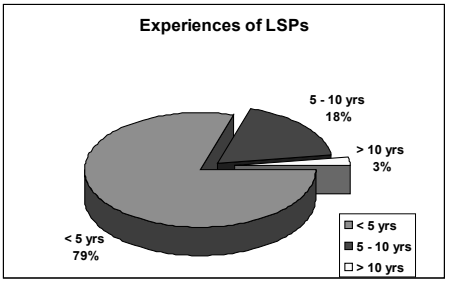
Source – LSP database

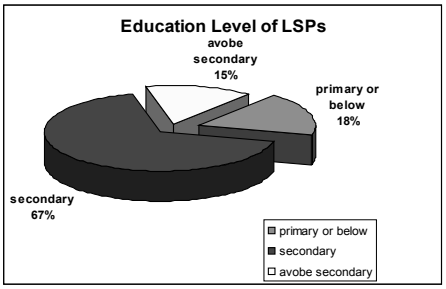
Outreach and service quality:

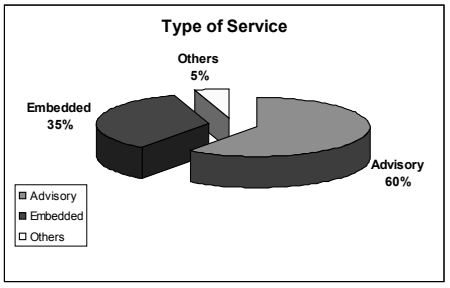
Average number of client per LSP is 282 CBO members and 187 community members (total 469 clients) which are observed from the LSP database. Monitoring data through specific exercise also reported that around 2,800 LSPs have established functional linkages with CBOs and CPs. Each LSP has linkages with 10 CBOs and 4 CPs within the geographical coverage of 1-3 unions within one Upazilla. About 87% LSPs collected demand from the CBOs and CPs. About 90% of the sampled CBOs reported that due to the services they received from the LSPs, the average income of the recipients (both CBO and non-CBO members) has increased by about 58% through implementing relevant enterprises. About 30% of LSPs' clients reported that the quality of LSPs' services is "very good", whereas 48% clients recognised LSPs' services as "good" and remaining 22% treated the services "moderate".











Source: LSP database

Source of Income and mode of service delivery:

There are diverse source of income for LSPs. During the field discussion and observation there are about 20 distinctive form of service delivery mechanisms found in the field. In addition to formal session in CBOs and CPs LSPs are selling services in following embedded form in lieu of cash or kind – i) skill like budding of Jujube tree, spraying of fruit tree; ii) making availability of quality inputs, especially vegetable seeds; iii) vaccination of poultry and cattle; iv) contract service for orchard management v) compost making and selling; vi) pond contact either profit share or monthly fee; vii) selling services to other project viii) package contact for beef fattening either of profit sharing, service contact only or service contact with input supply; ix) establishing service centre; x) Buck centre what is that ?; xi) commission from private companies; xii) session support to other project like training PKSF projects; xiii) agency-ship of input companies; xiv) facilitating in marketing of produces e.g. medplant delivery to company, selling fatten beef; xv) paid advisor in seed store and vet medicine store; xvi) Referring charge and assistantship share from doctor e.g. TBA, Livestock LSPs; xvii) deployment by processing company e.g. manager of milk collection centre; xviii) contact farming jointly with producers, e.g. fish, field crop etc.; xix) support service to demonstration by the companies etc. In addition to that many of the LSPs in different type of IGAs and MSE by themselves which is important both for service demonstration and earning.

Commercial LSPs are providing two types of services, i.e. i) advisory services alone, and ii) advisory services embedded with inputs and/or skill. For professional LSPs - it was observed that about 43% LSPs are providing only the advisory services (overall is 60%) whereas 57% LSPs (overall 35%) are providing services embedded with inputs like quality seeds of vegetables and paddy, fertilizer, pesticides, fish fingerlings, etc. Services embedded with inputs were found to be more promising both for both the LSPs and the customers, as one hand the clients have easy access to their required inputs and services together, and on the other hand the LSPs can easily sell both inputs and services with a better profit margin. Livestock services including poultry vaccination was found as the most demanding and commercially viable service for the LSPs. It was observed that the LSPs who sold their advisory services in the domain of livestock including poultry rearing, vaccination, beef fattening etc. could earn 3000/- Taka per LSP per month.

It is estimated an amount of about 4.8 million taka had been earned by the LSPs through selling services in 2008 (source: LSP database). One of the parts of their income came through conducting session in CBOs/CPs where the project has contribution (14.5%). In 2008, beneficiaries contributed 60-80% of the service charge (training fee) of LSPs while conducting formal training to the communities. Remaining part of 20-40% of the training fee was borne by the project, which was 15% lesser than that of previous year. In some cases project contribution was more, particularly in case of new CBOs and remote areas like Sunamganj. It was observed that the contribution of the clients did not increase as much as the project had envisioned. However, this contribution from the project is still important for institutionalising the whole service provision. It helps for rapport building between community people and LSPs, creating demand for further services, developing confident within LSPs etc. Though principally it was assumed that when people will be introduce with the door step services, they become generous to purchase the services. In case of session conduction it is not visible too much. Rather individuals who have already involved or think to be involved into particular IGA or MSE, they are eagerly searching the services and paying accordingly, for instance beef fattening, back yard poultry, establishing orchard, fish culture etc.

Service Centre

The service centre had been evolved as a commercial service selling point of professional LSPs and gradually establishment of service centre is getting momentum. Upto December 2008, a total of 124 service centres were established by the group of LSPs. Service centre is basically established in public places like in local hat, bus stand, market places etc. to attract the clients and ensure a certain contact places for them. And LSPs are sitting over there in the evening and market days. It is also used for store house of quality inputs what LSPs suggested to client to use. The relationship between Service Centre and SPA is not clear and different in nature in different places. The establishment process is dismal across the regions. Through successive workshops the ideas were tried to accumulate by the project and tried to make some standard point on consensus. By this exercise, it was tried to summarise what to do or not to do. So far, LSPs got interest in such type initiative, especially by the livestock LSPs and they feel it as a good potential for their service market.

Criteria for Service Center

- It is the commercial intervention of some interested LSPs who resides in and around
- A group of LSPs should be involved (individual initiative or establishment will not be treated as service centre, rather a business)
- it should be located in public places (individual's home will be discouraged)
- Service centre could be a place for the LSPs of all domain or for particular domain
- Good relationship and understanding with SPA is expected
- Only input selling will not be focus, rather service will be focused and input will be embedded as follow-up support
- Service centre can establish linkage with input suppliers, companies etc.
- If SPA facilitate the private companies or distribute inputs through service centre, commission or profit share will be settled by negotiation
- Contribution to SPA is not mandatory

Lessons learnt:

- Promotion of LSPs created two fold benefit in the rural community - self-employment and access to required updated Knowledge, Technical and Information for poor HH at their door step

- People are paying for desired agricultural services and embedded service is proven most viable for continuation as both parties are benefited from this sort of service mechanism
- Livestock services are most income generating – the average income per LSP per month is 3500/- in livestock service
- Contact services turned into igniter of different IGAs, MSE/SME as well as enhanced economic growth
- Comparative young person having little education were found effective as the LSPs.
- Specialised trainings for LSPs in diverse areas were found to be essential to satisfy the growing demand of various types of on-farm and off-farm MSEs and value chains
- Active involvement of SPAs in local government bodies, development platforms and coordination committees at sub-district and district levels was found to be a good strategy to make the public services available for the poor
- Commercial orientation and entrepreneurial capacity are a prerequisite for the SPAs to create and expand their service markets.
- Livestock village, fruit village, duck village, etc were observed to be the best location-specific options to fight the poverty of the whole community through bringing all relevant actors together.
- The evidence of Public-Private Partnership (PPP) initiatives (e.g. ginger rot management, beef fattening, milk village, livestock village etc) were found to bring good results, which focussed more attention to formalise and consolidate these types of initiatives.
- Inclusion of more private sector organisations in the programme created a wider avenue to enhance the employment and income opportunities for the poor and extreme poor. This emphasised the need to explore further opportunities of Corporate Social Responsibility from private sector organisations
- Person in position in the line agencies as well change in that position can negatively influence the effectiveness of service provision
- Due to lack of ownership and specific vision local coordinating platforms are not functioning
- Working with whole value chain create more competitiveness in the service delivery system

Challenges for the future:

- Improve the service quality of LSPs in terms of technical competency and acceptances by all type of clients (especially by MSE and value chain)
- Developing a self driven system for monitoring the service quality of LSPs

- Ownership by stakeholders in promoting private local service provision
- Make the SPA as driving force in the service provision
- Phasing out of project's role to CBO for getting services
- Synergies and harmonisation with other projects, NGOs, line agencies specially for developing service infrastructure
- Involvement of more private sector in the service delivery system
- Settlement of service mood in relationship between SPA/LSP and private companies

Conclusion

Agroforestry community service provision has already proven its potential by accelerating the local economic growth in particular places. Emerging of LSPs in the community created two-fold benefits in the rural economy – ensure easy access to demanded knowledge and services at local level even by the poor and extreme poor in one hand, generate self-employment opportunities for the LSPs themselves on other hand. Lateral learning and exchange of innovation across the regions could benefit all. Still special attention is needed for institutionalisation of whole service provision system. For this more collaboration at local level with all agroforestry line agencies and private sector is very critical. Due to lack of much involvement of local public sectors, LSPs/SPAs have to face different obstacle often. Harmonization with likeminded organisations/projects could also accelerate the process. All most all stakeholders who came across the local service provision activities, they recognised the potential of it. Therefore, it has immense opportunity to make the agroforestry service provision more functional and institutional for more sustainable growth.

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Species Selection for Agroforestry System Development and Management

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Abstract

Objective of this study was to identify tree species and under storey crops suitable for agroforestry systems development and management, and approaches to be taken for future improvement. Results of the study showed that 80% women participating in survey had shown their preference mainly in fruit, fodder and forage species to be grown in agroforestry systems. This result clearly indicated that women of study areas preferred fodder and forage species, while men preferred timber and fuel wood species. Tree shade had been noted as one of the main constraints for agroforestry systems development and management in study areas. To minimize this problem, shade tolerant agriculture crops have been recommended to grow as under storey crops. Another method for reducing shading effects of trees on under storey crops was tree management doing coppicing, pollarding and lopping in fodder species, and pruning and thinning in timber species. Finally, approaches recommended by women and other key informants of this study for fruit, fodder and forage development and management under agroforestry systems include community forest user groups to supply seeds, slips and cuttings to local community for plantations along landslide, roadside and gully treatment. The fruit, fodder trees and forage species production has an opportunity to grow on-farm or backyard through school fodder and forage programs to educate students about fodder and forage development and management under silvi-pastoral system to support livestock production system of Nepal.

Key words: *Agroforestry, preference, fruit, fodder, forage, shade, crop.*

Inroduction

Women in Nepal have been working in forestry and agriculture development sectors to fulfill their basic needs of food, fruits, fodder, forage, leaf litter, fuel wood and timber, and also have played an important role in these resource development and management activities by creating awareness. Some women farmers of study areas are also involved in growing trees and improved grasses on their farmlands, which have been playing a better role in increasing agricultural productivity by nutrient recycling, reducing soil erosion, improving soil fertility and enhancing farm income compared with

conventional crop production.

Due to the increase in population, there is still huge pressure on forests to meet the needs of forest products, and therefore, many farmers in rural areas of Nepal have been planting trees on their marginal lands, farmlands, community forests, leasehold forests and other communal wastelands to meet such shortages of forest products. However, there is a gap of knowledge about the trees, grasses and crop species to be selected in different forestry as well as agroforestry plantations. To fulfill this gap, study on species selection for agroforestry systems development and management has been conducted in six Community Forest User Groups (CFUGs) of Makwanpur, Chitwan, Dhading, Gorkha, Tanahu and Lamjung districts.

Objectives

The general objective of this study was to identify tree species and under storey crops suitable for agroforestry systems development and management in study areas. The specific objectives were:

- To identify tree species, improved grasses and crops suitable for agroforestry systems development and management.
- To assess the constraints associated with agroforestry systems development and management in study areas.
- To analyze the approaches for fodder and forage development under different agroforestry systems.

Methodology

Study Site Selection

Six Community Forest User Groups of Makwanpur, Chitwan, Dhading, Gorkga, Tanahu and Lamjung districts were selected (Table 1) for the study because the ecological and socio-economic status of CFUGs were diverse, and CFUG members especially women were also highly interested and cooperated for proposed study. In addition, they were doing some agroforestry related activities in their farmlands as well as in community forest areas.

Table 1: Community Forest User Groups and respondents of the study

Name of Community Forest User Groups	Address	Women	Men	Total
Simpani Devkot CFUG	Manahari-4 & 9, Makwanpur	22	8	30
Panchakanya CFUG	Ratnagar-10, Chitwan	13	12	25

Kalikasthan and other neighboring CFUGs	Kalleri-3, Dhading	21	9	30
Rajdevi CFUG	Majuwa-Deurali-5, Gorkha	15	10	25
Bankali CFUG	Udipur-5, Lamjung	29	6	35
Jumdanda Jhapri and other neighboring CFUGs	Bandipur-6, Tanahu	21	9	30
Total		**121**	**54**	**175**

Data Collection Methods

For this study, both primary and secondary information were collected using Participatory Rural Appraisal (PRA) tools and technique, which were Key Informants Survey (KIS), Focus Group Discussion (FGD) and Direct Observation of farmlands and forests, and reviewed of publications related to agroforestry development and management. Discussion of these techniques had been presented below:

a) Discussion with Key Informants

Discussion with CFUG executive committee members, local teachers, CFUG members-women, and aged persons of the study CFUG areas, DFO, DSCO and DLSO staff and other line agencies supporting CFUG members to deal with trees and grass plantation, and agroforestry development and management, and Federation of Community Forest Users, Nepal (FECOFUN) members were also consulted for the assessment of species to be included in agroforestry practices, identification of constraints associated with agroforestry system development and management, and approaches for fodder and forage development under agroforestry systems.

b) Focus Group Discussion (FGD)

This discussion was organized with women of different ethnic groups and socio-economic background of studied CFUGs involved in trees and grass plantation as well as in agroforestry related initiatives. Discussion was focused on history of forest development and management, trees and improved grass plantation in marginal lands, farmlands, community forests, leaseholds forest areas and other waste lands, and species to be included under trees. In addition, constraints of agroforestry and approaches for fodder and forage development under agroforestry systems also identified during focus group discussion. Some experience men of studied CFUGs were also involved in focus group discussion.

c) Direct Observation

Direct observation of forests, farmlands and agroforestry practices were also done during the field visit with CFUG members. The strength, weakness, opportunity and limitation (SWOL analysis) of each observed activities were also analyzed from direct observation.

d) Review of Reports and Publications

Secondary data related to the study were collected to supplement primary data. The main source of secondary data were CFUG records, and DFO, DSCO and DLSO profiles and reports, FECOFUN reports and reports of other line agencies, and agroforestry related published and unpublished documents, literatures and journals.

Results and Discussions

The study results revealed that the participation of women in study was significantly higher than men, and 85% of them were literate farmers. Therefore it is very important to introduce any agroforestry practice in a demonstrative way to have effective diffusion in study areas. A major portion of the study population (60%) was found growing 20-50 trees and fruit trees on their farmlands. However, 25% of the respondents were having only uto 19 trees and fruit trees on their farms. Only a small number of respondents (15%) had grown more than 50 trees and fruit trees on their farmlands.

Tree species grown on farmlands along with agriculture crops in study CFUGs included tanki (*Bauhinia purpurea*), koiralo (*Bauhinia variegata*), kavro (*Ficus lacor*), Ipil-Ipil (*Leucaena leucocephala*), dudhilo *(Ficus nimarolis),* kutmiro (*Listsea polyantha*), debdabe (*Garuga pinnata*), kimbu (*Morus alba*), khanyu *(Ficus semicordata),* badahar (*Artocarpus lakoocha*), sissoo (*Dalbergia sissoo*), masala (*Eucalyptus spp*), uttis *(Alnus nepalensis),* chilaune (*Schima wallichii*), bakaino *(Melia azedarach), and* siris *(Albizia spp)etc.*

Fruit trees grown under agroforestry systems in study CFUGs were different citrus fruits, mango (*Mangifera indica*), guava (*Psidium guajava*), papaya (*Carica papaya)*, pineapple (*Ananas comosus*), Peach (*Prunus persica*), Plum (*Prunus domestica*), litchi (*Litchi chinensis*), Banana (*Musa paradisiaca*) and jack fruit (*Artocarpus hetrophyllus*) etc. About 30% respondents had also grown broom grass (*Thysanolaena maxima*) and improved grass- mott napier (*Pennisetum purpureum)* along terrace bunds, borders and slopes.

Species Preference

Majority of the female respondents (80%) had shown their preference mainly in fodder and forage species, while 75% male respondents had preferred to grow trees for the purpose of timber and fuel wood. The analysis further showed that 20% female respondents preferred trees under agroforestry systems for timber, fuel wood and fodder, and 25% of male respondents also preferred fodder and fuel wood species to be grown under agroforestry systems.

The main reasons for selecting fodder and forage species by the female respondents were to reduce their work load for fodder and forage collection and to increase income from livestock production. The highly preferred fodder species by women included badahar (*Artocarpus lakoocha*) followed by tanki (*Bauhinia purpurea*), koiralo (*Bauhinia variegata*), kavro (*Ficus lacor*), Ipil-Ipil (*Leucaena leucocephala*), dudhilo *(Ficus nimarolis),* kutmiro (*Listsea polyantha*), debdabe (*Garuga pinnata*), kimbu (*Morus alba*) and khanyu *(Ficus semicordata),* and forage species was broom grass (*Thysanolaena maxima) followed by* forage peanut (*Arachis pinotoi),* mott napier *(Pennisetum purpureum),* setaria *(Seteria splendid),* mulato (*Brachiaria brizantha x B. ruziziensis),* stylo *(Stylosanthes guianensis),* clover *(Trifolium spp) and* desmodium *(Desmodium intortum).*

Species selected for timber and fuel wood production under agroforestry system by male respondents were sissoo (*Dalbergia sissoo*), teak (*Tectona grandis*), masala (*Eucalyptus spp*), uttis *(Alnus nepalensis),* chilaune (*Schima wallichii*), chanp (*Michelia champaca*), bakaino *(Melia azedarach), and* siris *(Albizia spp).* The highly preferred fruit species by both male and female participants for agroforestry systems were pineapple, papaya, pomegranate, guava, peach, plum, citrus fruits, banana, litchi and mango etc.

Constraints of Agroforestry

Majority of both male and female respondents (90%) noted tree shade as one of the main problem for agroforestry system development and management in study areas. To minimize this problem, shade tolerant agriculture crops such as ginger (*Zingiber officinale)*, turmeric (*Curcuma longa),* chilli (*Capsicum annuum)*, yam (*Dioscorea oppositae),* colocassia (*Colocasia esculenta),* sweet potato (*Ipomoea batatas*), pineapple (*Ananas sativus),* and forage species such as desmodium and forage peanut were recommended to grow as under storey crops. In addition, cash crops such as coffee (*Coffea arabica*), cardamom **(***Amomum subulatum*) and tea (*Camellia assamica*) were also needed light to medium tree shade for better production, and therefore, nitrogen fixing trees such as Ipil-Ipil had been suggested to grow for shade to coffee, while uttis for cardamom, and sissoo and siris for tea, and non-legume *popular* species for winter wheat farm. Another method for reducing shading effects of trees on under storey crops was tree management practicing coppicing

in mulberry, pollarding in badahar, tanki, koiralo, dadabe, kavro, Ipil-Ipil, dudhilo etc and lopping in all fodder species, and pruning and thinning in timber species.

Additional constraints of agroforestry systems development in study areas included small land holding followed by scarcity of seedlings, cost for plantation establishment, plantation protection problems, legal problem in transportation of tree products, lack of transportation facilities up to farm sites and lack of awareness about the importance of agroforestry system development and management.

Approaches for Fodder and Forage Development

The best approaches recommended by women, men and other key informants of this study for fodder and forage development and management under silvi-pastoral system to support livestock production system had been discussed in following section:

Fodder and forage resource sites establishment

Livelihoods of community forest user group members had been depending on livestock farming, and vast majority of women respondents were highly interested in fodder and forage program. Therefore, fodder and forage resource sites should be established to reproduce fodder and forage seeds, slips and cuttings, and seedlings in forest user group areas. For this, interested progressive farmer should be selected, trained and provided with fodder and forage seeds, slips and cuttings. These sites should focus to produce slips and cuttings of *Mott Napier, Forage peanut, Setaria, Mulato, Amriso (Broom grass) and Desmodium* and seeds of *Stylo*, *Wynn Cassia*, Ipil-Ipil, Mulberry, and seedlings of Badahar, Tanki and Koiralo etc and then it should be supplied to all forest user group members. This is a cost-effective and efficient programme for expanding fodder and forage development activities on-farm lands and in allocated forest lands using agroforestry techniques.

Majority of respondents (80%) had also suggested that fodder and forage development program with vegetative propagation techniques provides greater opportunities for farmer to farmer extension than that of from seeds and seedlings.

Community fodder and forage programmes

About 85% respondents had suggested community fodder and forage approach because community forest user groups had capacity to develop allocated community forest lands as community fodder and forage plots. To increase the supply of fodder and forage available on community lands, the user group members should work together to prepare lands and develop such highly degraded community lands into fodder and forage blocks adopting silvi-pastoral practices. The outcomes of this program

would demonstrate that community fodder and forage program can play a vital role in improving the livelihoods of the poor and marginalized group members supporting to livestock farming. Both legume and non-legume fodder and forage species should be grown under community fodder and forage programs.

Landslide, roadside and gully treatment using fodder and forage species

Majority of respondents (92%) recommended landslides, gullies and newly constructed roadsides stabilization using fodder and forage species because these sites had the potential to be a fodder and forage sites and great resource for poor and landless households of forest user groups to collect fodder and forages needed for supporting their livestock farming systems. Unfortunately, most of these sites are now covered by *Banmara* weeds, which are unpalatable to animals. Sowing fodder and forage mixtures not only provide forage materials for livestock but also helps stabilise fresh landslides, gullies and roadsides, and reduce soil erosion. Fodder and forage mixtures should be prepared with two main aims: to provide a variety of species and land uses, and to maximise the yield per unit area.

On-farm fodder and forage production

Almost all respondents (95%) had recommended on-farm fodder and forage development work to promote agroforestry systems in study areas. The main species recommended by respondents to be grown along terrace bunds and borders and in backyard fodder and forage blocks were erect grasses such as Mott napier, Mulato, and Setaria, Broom grass and a range of leguminous species including Forage peanut, Stylo and Desmodium, Ipil-Ipil and non-legume Mulberry and Badahar etc. Most of these species can also be multiplied vegetatively through slips and cuttings. Cutting of Mott napier, Setaria, Mulato, Forage peanut, Desmodium and Mulberry should be prepared keeping 3 nodes, and slips of Mott napier, Setaria, Mulato should be prepared separating plants from main bush.

School fodder and forage program

Majority of respondents (90%) suggested a fodder and forage development programme, which should be designed to reach school students with the support of the District Education Offices. Its goals should be to create awareness about the improved fodder and forage crops and to broaden the

scale of fodder and forage cultivation programme under different agroforestry systems. The process for school fodder and forage programs implementation included provision of technical information, fodder and forage mini-kits- especially forage slips and cuttings, and seedlings of fodder species to school students, and hands on support provided to the students about land preparation, slips, cutting and seedling plantation/transplanting, protection, management, harvesting, and use of forage materials whenever needed to livestock. Species recommended for this program were Mott napier, Mulato, Setaria, Broom grass and a range of leguminous species including Forage peanut, Stylo and green leaf desmodium, Ipil-Ipil and non-legume Mulberry and Badahar etc.

Conclusion and recommendation

The study concludes that traditionally people were growing fodder, fuel wood and timber species, and fruit trees in addition to naturally regenerated species in the study areas. However, intervention by the projects had also promoted planting of fast-growing species such as Ipil-Ipil and improved grass such as Mott Napier. The study revealed that female respondents were highly interested in fodder and forage development and management under different agroforestry systems. Therefore, the GoN, I/NGOs and projects working to promote agroforestry systems in study areas should give priority in fodder and forage species. This program not only reduces the work load of women for fodder and forage collection but also increase income of women from livestock production.

Practice of Agroforestry for Secure Livelihood and Food Security in the Rim of the Kathmandu Valley: A look at Madhevasthan, Matathirtha and Machegoan Villages

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Abstract

The three villages of Madevasthan, Matathirtha and Machagoan are located on the south-west rim of the Kathmandu valley. These villages were historically important centers of cultural life and in olden times the hub for political state craft. In fact, during the Licchavi period (ca.100 -200 AD), Kishiphiri, meaning "where elephants were traded", was the capital of the Kathmandu Valley. It lies in the modern day Matathirtha village next to the famous mother's shrine called Matathirtha.

These villages with a mixed population of Newars, Tamangs, "khas" Brahmin and Chhetri caste plus other ethnic groups. These groups have kept the tradition of keeping cows, buffaloes, goats, sheep and other small animals for livelihood, rituals, trade, milk, meat and other dairy products. The practice of agro-forestry looks into the important agrarian activity of managing these livestock through feeding regime and nutrient supply in the villages thus providing invaluable food security and livelihood opportunities. In addition, the paper examines the issue of migration to the capital Kathmandu, on short term or long term basis, thus providing a challenge to finding human resources to carry out the daily activities of Agro-forestry within the farm and the nearby forest. Feminisation of agriculture and the role played by women are paramount in this situation.

Key Words: *Agroforestry, community forestry, women's groups, mulch, litter, manure, fodder, livestock, food security, livelihood, migration.*

Background

The southwest rim of the Kathmandu Valley which comprises the villages of, Madevesthan, Mathathirtha and Macchegoan had seen wanton destruction of the government owned but poorly managed forest. These villages lie below the Chandragiri hills massif which is over 8,000 feet high. The Chandragiri watershed and the villages, form an important watershed area for many of the villages

downstream. It also feeds the small rivulets, water bodies, aquifers and river systems lying on the valley floor. The watershed is an important "ecological hotspot", for it contains a number of wildlife such as deer, civet cats, leopards, pangolin, porcupine; and wild rabbits. This area is also ideal for bird watching as many rare birds such as pheasants, cuckoo, long tailed magpie and robins, barn and spotted owls are found here. Besides, it is also a "highway" for winter birds migrating south and those birds from the inner tarai migrating to the Kathmandu valley and beyond north in spring and summer. It is also home to native Asian bee (*apis cerena*) and many varieties of rare and beautiful butterflies including the rare indicator species such as the fire flies.

Housing and infrastructure construction activities boomed in the Kathmandu valley rapidly during the 1960s – 1990s. The hills straddling the Chandragiri watershed area were a prime source of quarry mines for low grade limestone which formed important material for foundation works in building construction in the capital Kathmandu. Massive mining of limestone led to severe top soil erosion, land degradation and deforestation. The heavy dependence of the houses in the Kathmandu valley during those days on charcoal and fuel wood have led to rapid denudation of the forest. Added to this factor was the illegal felling of trees for local needs such as construction of houses, fencing materials and for making furniture and agricultural tools. Charcoal and fuel wood was also burnt, cut and supplied illegally and surreptiously to respond to the demands of the capital Kathmandu.

It is only after 1990s, when both multiparty political system and community forestry was introduced actively into this area did one notice the resurgence of community forest. This has resulted in an increase of bigger unit livestock such as cows and buffaloes currently kept by households for milk, dairy products and farm yard manure. Before, this era, local families kept mainly goats and small animals such as rabbits and some pigs.

Livelihood, Livestock and Agroforestry

Most of the families, until the very recent past, were from agrarian background and lived a traditional rural life. It is only now that livelihood and lifestyle patterns are changing. As a result, these areas are urbanizing rapidly and are being subsumed into greater Kathmandu valley metropolis.

Local Livelihood

Traditionally, most of the families are dependent on farming and raising small livestock such as goats. The poorer ones also earned some income by burning charcoal in the forest; cut fuel wood and sold it in the Kathmandu market. Some others brewed alcohol and sold it in the market. Most of these activities were illegal and the families had to do it discretely in the dead of the night. The politically

and economically active family either worked on the local stone quarries as petty contractors and entrepreneurs or kept few trucks as transport services in the Kathmandu valley or adjoining growth centers.

Local employment were few and some family members obtained employment in lower rung of the services hierarchy in public services such as the Tribhuvan University Campus, Nepal Electricity Authority, Salt Trading Limited, National Trading Company or the Nepal Ropeway which then spanned from Kalimati in Kathmandu to Hetauda through these villages.

As a result, most of the family members worked on the farm-land, raised some livestock mainly chicken and goat and also went in search of daily wages as laborers or farm hand workers. A few lucky ones had jobs in either private companies commercial outlets in Kathmandu or the public services and institutions. Agricultural activities, livestock raising and keeping some bees and growing fruits in order to supplement household income were the normal activities in these households.

The families in these villages dependant on livestock, agriculture, petty trade, labor, and small jobs as coping strategy to meet the households basic needs of food, shelter, clothing, health, education and social obligations.

Agriculture, Livestock and food security

Agriculture consists of growing rice, maize, millet, wheat, mustard, soya and vegetables such as radish, spinach, beans, peas and broad beans. Winter crops were rare but in the last few years "off-season" vegetables such as tomatoes are grown on rudimentary plastic greenhouses. Winter crops are still rare and mustard is grown in order to obtain oil. Agricultural residues such as hay, corn cobs, and dried maize stalks or soya stems are important feed for animals. Now days, there is also serious competition for rice husk and rice stalks; since the mushroom industries use them for thatching. The rice husk is also used in the brick kilns that have sprouted in great numbers around these villages. This has created a serious situation for soil fertility and lack of nutrients from agricultural residues. At the same time, it has also created a scarcity of fodder and food for the animals.

Most of the families living in these villages are small plot holders. A majority of them own either half a hectare or less land. This means that there is less than 12 months of food self-sufficiency. A majority of them have either six months or less of food supply from their own farm. In this situation, farm animals, especially goats, play an important role for the poor followed by buffaloes and cows in order to earn supplementary income. A few families have begun to keep pigs in a managed manner. All these animals require food and fodder which must come from the land and the nearby forest.

Traditional Farm Forest nexus and the need for improved Agro-forestry model

The relationships between forest, farm, and nutrients are very obvious in these villages. It further promotes or hampers soil quality, porosity, soil productivity and nutrient cycling. One can visibly see that women contribute most to the forest and farm activities in these villages. It is in the form of collecting and foraging for grasses; loping fodder trees either found in the farm or forest, collecting dried wood as fuel wood or even cutting young pole size green trees for fuel-wood; collecting leaf letters and even "*bokashi*" or well rotten leaves and grasses from the forest floors; collecting medicinal plants such as *cheritoos (Swertia Chariata)* or *timur/timbur (Zanthoxylum)* or collecting nettle leaf sisnoo (*Urtica dioica*) as vegetables. During spring young women and boys can be seen collecting *asielo* (wild rasp and goose berries); kafal (*Myrica esculenta)* and *lali gurans* (*Rhododendron* spp).

One obvious scenario is that of women in groups going up the slopes with herds of goats, cows, and buffaloes; so that they can graze in the adjoining community forests. They come down in the afternoon when the livestock have had their quota of grasses to vet their appetite. The women folks then make "*kudo*" or animal feed from rice, flour, soya cake, salt and other cereal grains to supplement the livestock's diet. This management regime is carried out twice a day and a majority of households will heat the meal before feeding the animals - thus requiring care, management, water, fire and fuel wood to sustain this livestock management system.

The women of these villages are also home makers, nurturers and managers of their households. It entails managing the family in terms of moods, mores and daily sustenance needs. Women in these households are, therefore, busy washing clothes, utensils, feeding the family members 3-4 times a day, managing the upkeep of the home, hearth and kitchen garden. These activities are closely tied in and related to farm activities, farm produce, and produce from the animals such as eggs, meat and milk; and produce from the intensely cultivated homestead kitchen garden.

In their cooping strategy to feed the family members and provide food security; women work intensely in the agricultural cropping cycle growing cereals, legumes, lentils, vegetables, fruits and spices such as onions and garlic or cilantro - which is produce within their limited homestead farming. At the same time, livestock complements women's efforts to provide food and income for the family and help the household members in the education, health and nutrition of their children.

Currently, women obtain grasses from the public lands and forests. Most of the public lands and parts of forests are rapidly occupied by a "*predatory state*" and the "*public institutions*" such as the army, police and the armed police force. It puts substantial burden on the natural resources such as water supply and food of these villages. At the same time, it curtails women's freedom to graze their

livestock in the public lands or even the forests as they used to in the past. The growths of community forests has had many benefits but have also presented "*un-intended consequences*" in the form of greater number of leopards roaming the forest. Leopards prey on domestic animals and even humans. Besides, monkeys are potential pests and destroy crops. At the same time wild boars, deer, rabbits and rodents compete with human population for food those posing both real nuisance and food insecurity. These new developments and changing eco-systems; do pose challenges to the sustainability and food security in the web of life of the inhabitants of these villages.

Fortunately, the community forests around these villages are currently supplying them with fodder trees and tree fodders including ground grasses. As a result, there is some succor and support for women to complement their household income thorough livestock management. Furthermore, it has helped in obtaining some timber from the Community Forest User Groups (CFUGs) for construction purpose including energy for cooking and heating mainly in the form of fuel wood. The increase availability of biomass in the community forests have also given women in these areas to collect more leaf litter in order to either use it as mulch or farm yard organic manure.

The general trees found here are uttis (*Alnus nepalensis*), Lapsi (*Choerospondias axillaris*), chilaune (*Schima wallachi*), chaap (*Michelia champaca*), bakaino (*Melia azedarach*) and salla (*Pinus patula*)

The importance of promoting bio-mass, fuel wood, water, moisture, mulch and manure

Currently, women in these villa ges depend on ground grasses from the river streams, public lands and forests to satisfy the need of livestock fodder. There is very little agro-forest or species of agro-forest trees, fodder trees, fruits or grasses that are planted in an "active management regime". In many other districts, where they have been greater awareness on the usefulness of agroforestry on farm and terrace itself for food, fuel, fodder, litter and grass production – the useful farm/forest nexus and productivity have been encouraging. One can notice this in say Ilam, Panchthar, Taplejung, Okhaldunga, Kavrepalanchowk, Sindupalchowk in the east. One can notice this in Palpa, Syangja, Kaski, Parbat and Myagdi as well. However, in the south west rim of the Kathmandu valley one finds very little agroforestry practices.

Current dilemmas related to Agroforesty in the south-west rim of the Kathmandu Valley

Whatever agroforestry practice there is in the three villages of Madevesthan, Matathirtha and Machhagoan is due to naturally occurring species. These are prorogated by nature in the form of

bird droppings, winders, pollination by bees or foraging animals such as monkeys and squirrels. The naturally agroforestry fodder trees found in these villages are dominantly *bakaino, pipla, dudilo, teemilo, gagun, chilaune* and *amliso*.

Even today villagers wrongly believe that planting fodder or timber trees will lead to their land being confiscated or nationalized by the government. Besides, many believe that the shading effect of fodder, fruits, timber and other varieties of useful trees, shrubs or grasses are harmful to the food production.

The resulting dynamics, tensions and conflicts for resources are fairly interesting and evident in these villages. These resource conflicts manifest itself in the form of internal intra-house hold conflicts due to poverty, migration to Kathmandu and overseas in search of jobs, conflict with institutions of the state such as army, police and District Forest Office and conflicts with neighbors and village officials.

What can be done ?

A few innovative ideas and approaches can be introduced in these villages. These are:

- An awareness programme providing knowledge, skills and practices, on the strength and benefits of farm level agro-forestry can be introduced in these villages.
- Willing households can be motivated to grow fodder, fruit and timber trees in their farm based on what works in the north-east facing slopes.
- Inter-cropping practices with trees and herbs can be introduced, i.e. cardamom, ginger and garlic.
- Riverine areas, gullies and degraded land can be given to the families in group to develop, protect, grow and use fooder trees, fruit trees and grasses for fodder, fuel and food.
- Women's group can be motivated, organized and empowered to practice improved livestock management, group production scheme for milk and meat or organize themselves into production and marketing groups such that their isolated actions finds much more effective market, sustainability and organization. Currently, each household are engaged in grazing activities. This could be improved into a rotational system where a select few carries out this activity on chronological basis thus freeing up time and energy of other women.
- Community and National Forests can also set aside plots and model farms where these women can experiment and develop agro-forestry practices including activities like group orchards for gainful income and employment.

In this manner, women at the household level can organize themselves and obtain benefits from government's stated policy of "prosperity from forest and farm sector". At the same time, specialized technical and management assistance from the government through forest, livestock, agriculture and horticulture extension agencies can work with these women groups to increase their agroforestry skills and productivity. Finally, the educational systems and universities both public and private help with action research by working closely with such women's groups. The women's groups themselves, through the facilitation of NGOs, CBOs and Farmers Cooperatives in the area can help to access support and input(s) from the government, private and educational instutions.

End Note: The above paper is based on the empirical and practical evidence, experiments, lived-in-experience and promotion of community development in these villages by the author as resident farmer and researcher for the past 35 years. It is a primary first person narration and no reference has been cited.

Agroforestry Management and Practices in the Middle Hills: Linkages to Improve Livelihood and Empowerment of Rural Women in Nepal

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Abstract

Agroforestry has been accepted as the best practice of natural resources management for the livelihood improvement of the rural women and poor. The critical role of gender in development discourse has been pointed out by donors, policy makers and development practitioners. In general, gender inequalities in areas like ownership and access to resources; land tenure systems, education, extension and training have contributed to decrease agricultural productivity and increase poverty levels. It is well known that the role of women in all spheres of agriculture production is very crucial. However, the role of gender is known very little in the adoption of agroforestry. This paper therefore intends to fill the gap by presenting a synthesis of the involvement of women relative to men in various agroforestry practices across the Middle hills in Nepal. However, women are disadvantaged due to cultural and socio-economic factors. The purpose of this paper is to examine the participation of women relative to men, highlight gender discrepancies so that strategies that challenge imbalances are addressed, thus ensuring that both men and women are able to make decisions, access resources equitably and get benefit from agroforestry. The paper begins by justifying why gender is important in development and why a lot of emphasis has been placed on women. This is followed with a highlight on areas in which women are disadvantaged. Finally, this paper puts forward recommendations on how to promote efficient participation of women in agroforestry with greater benefits accruing to them.

Key words: *Agroforestry, practice, livelihood, gender, natural resource, participation, benefit.*

Introduction

Tree protection and plantation on farm is very ancient phenomenon in the hills of Nepal. It has been realized as a potential strategy to meet the needs of local people and protect the environment during 1970s. In this decade forest protection and management has taken momentum worldwide and several popular terms has been coined for the promotion of "forestry" such as social forestry, community forestry and agroforestry (Tamale et al, 1995; Nair, 1993; Foley and Barnard, 1984). Although these are the terms coined are for age-old practices in local community, however, specialists made distinctions among them defining a precise technical meaning (Barraclough and Ghimire, 1995). Social forestry in wider sense is taken as an umbrella includes the practice of planting or using trees to pursue social objectives through delivery of benefit to the local people. Community forestry, farm forestry and

agroforestry are all forms of social forestry (Nair, 1993; Hobley, 1996; Tamale et al, 1995). Community forestry is a part of national forestland handed over to communities for the purpose of management and wise use of forest resources (Nair, 1993; Hobley, 1996; Tamale et al, 1995; MPFS, 1991). Agroforestry is a collective name for land use systems and technologies involving trees combined with crops and/ or animals on the same land management unit (Nair, 1993; Tamale et al, 1995).

Agroforestry system in Nepal is broadly described in two categories: farm–based and forest-based practices. The farm-based practices are home gardens, planting trees on and around agriculture fields, tree wood lots and commercial crop under shade trees or agriculture crops inter-cropped with commercial trees. The forest-based practices involve specific agricultural practices associated with forests where farmers collect food, fruits and gums (Tejwani and Lai, 1992). This paper comprises the study on farm-based agroforestry practices.

The main source of livelihoods for the people in the hills of Nepal is the farming. Trees on farmland or the forestry is an integral part of the farming system. Fertilizer and nutrients for cropland come from animal manure and leaf material. Construction timber, firewood, fodder, grass and bedding materials for livestock all come from both the farmland and forests. Forest and trees are also important for the protection of environment and conservation of biodiversity (Gilmour and Fisher, 1991; Grimble et al, 1994). The increasing human and livestock population have generated enormous pressure on forest and arable land for food, fuel and fodder, which leads to depletion of natural resources thereby affecting natural and human environment (MPFS, 1991). It has been estimated that forest in Nepal in 1964 was more than 45% of the total land area where as it has been shrunk to 39.6% at this stage. This has got significant impact on rural women and girls, who are responsible for fetching water and collecting fuel wood. On top of it, agroforestry plays a crucial role to meet the need of the growing population in terms of sustaining agriculture and livestock, production of commodities for exchange and as a form of energy and providing diverse tree products for sustaining rural livelihoods (Chew, 2001; Arnold, 1997). In the process of on farm tree management practices, farmers look at the that trees as a part of farming systems but not as a part of forest resource, rather farmers see trees in terms of h contribute to their livelihood needs strategies (Arnold and Dewees, 1998). However, agroforestry practice provides higher financial return to land-rich and lowers financial return to the land-poor households (Foley and Barnard, 1984; FAO, 1989).

Agroforestry Systems in the Hills

Different agroforestry systems are being practiced in different areas in the hills of Nepal. The commonly practiced agroforestry systems on the basis of nature of components are the following: Agrisilviculture, trees with crops combination; Boundary plantations, trees on boundary in combination with different crops; Block plantations, different tree species in combination with crops; Alley cropping, different shrubs in combination with crops; Agrihorticulture, different fruit trees in combination with crops; Agrihortisilviculture, forest and fruit trees in combination with crops; Agrisilvipasture, trees with crops including pasture and/or, animals; Silvipasture, trees with pasture and /or animals; Forage forestry, forage trees with pasture; Hortipasture, fruits trees including pasture and/or animals; Live fence, different shrubs with trees on boundary; Homestead, multiple combination of forest and fruit trees, vegetables and cash crops; Entomoforestry, trees with sericulture and bee keeping and Aquaforestry, trees with fisheries (Ahlawat et al 2009).

Importance of Agroforestry in Farming System

Agroforestry is very important from the perspective of socioeconomics and livelihoods in the farming system.There are a vital relationship between socioeconomics and agroforestry system. The value of agroforestry in the farming system is very traditional and culturally accepted. In the farming system it is directly related to "how the community views and values it" dependent on the status of agroforestry. Therefore, understanding the fundamental dynamics between social values and economic values of agroforestry is essential for those interested in development of agroforestry in the farming system. Divergence between agriculture crop production and forage production sometimes setback the spirit of agroforestry development. For example, the balance of trees and crops in the subsistence farming system is very crucial from the perspective of sustainable development and environmental protection. However, the better understanding of socio-economic aspects can be aid to sustainable development. So, importance of agroforestry system for the society is as follows:

(A) Benefits from Agroforestry

(a) Fulfillment of basic needs

Agroforestry can fulfill the following four basic needs of the rural poor. (i) Food grain (ii) Energy as fuel wood (iii) Fodder production to increase milk and cash (iv) Shelter to provide construction timber for housing.

(b) Employment Generation

Agroforestry practices in the rural areas can generate additional employment broadly in two ways firstly; additional labour force is required for management and maintenance of trees and crops. Secondly new jobs could create to harvest the agroforestry produce generating rural employment opportunity.

(c) Improvement of degraded land

Integration of trees into land use systems have got various benefits for the improvement of soil fertility and nutrient cycling in the soil there by increases the crop yield. Thus, agroforestry practices improve soil fertility, conserve soil, improve moisture retention capacity in the soil and help to reduce wind erosion. It is also expected from agroforestry that provide Shelterbelt, extending shades and provide biological corridor for small rodent species.

(d) Increase income

Adoption of agroforestry system may increase the yield from per unit land area. It helps to improve livelihood security of rural households with the diversification of sources of family income. However, successful agroforestry venture may increase the production of milk and meat, which ameliorate household income. For successful agroforestry practice good planting materials and appropriate knowledge of agroforestry management skills are required. It is also urgent to examine adequate market prospects to increase households' income from agroforestry products.

(B) Environmental and Social Benefits from Agroforestry

Agroforestry practice in the farming system in the hills also makes environmental and social benefits from various ways. It could contribute to establish stable agriculture system and protect national and

community forest resources by providing alternative supply of fuel wood and forage. Agroforestry practices in the hills have got high scope of diversification of products in several ways like; the production of cash crops e.g. turmeric, ginger, chilly, coffee; production of groom grass, forage also creates new employment opportunities in the rural areas. Thus, it helps to provide employment and income for rural poor and also helps to slow down migration from rural to urban areas.

Why less effort of women in agroforestry ?

In spite of crucial role of women in the development process in Nepal, though, women are not fully activated in development program either in the agroforestry or, others. Nevertheless, women are continuously engaged in agroforestry program in a traditional manner. In well planned and designed agroforestry program women's involvement is quite less. Without consideration of women in agroforestry system its success and/or, implementation could remain incomplete. Practically, in rural farming system collection of fodder, forage and fuel wood is carried out by women. At the same time, women have to look after their children, preparing meal for family and cleaning of houses. Apart of this, women would not have much time to effort in agroforestry program as expected. Women have traditionally played important roles in agricultural production and in the use and management of trees. The importance of these roles is, however, obscured by the following prevailing triple roles of women.

Reproductive role of women

The reproductive role of women comprises the realm of responsibilities including all of the aspect of child birth, child raising and household work that ensure the sustainability and contribution to labour force. This role also includes food production and meal preparation, regular house work and caring for the children. The primary domain and responsibility of women are washing, cleaning, sweeping and caring of children and other domestic work. Particularly, girl children assist to mother/ women to fetch water, sweeping and washing dishes. Men typically do not take care of small babies and children, so the mothers must engaged in it. Women are also responsible for small stock husbandry and the feeding of large livestock. Thus in agroforestry system, where fodder, trees, the servicing of crops by trees or intercropping of crops involves, participation of women is necessary. In most cases women look after the livestock and care to grow crops.

Productive role of women

The productive role refers to income generating activities and commercial market pursuits. The productive role comprises work done for cash, or other form of payment. Any activity, whether it be a part of the formal or, informal economy, that generates income is considered to be productive work.

Activities commonly done by women include selling of surplus crops, milk and butter in the village, agriculture labour and activities associated with women groups. For many of the women income is to pay school fees and buy household items is a part of their daily activities. Women often spent morning of a typical day either digging in their own field or, collecting fodder and forage for their cattle. Then they work in others fields in the after-noon on daily wages. If they could not find the work then they set up to work in their own household work.

Woodlots used for commercial production is considered to be the work of male domain, however in the female headed households it is being undertaken by women. In such cases women planted

trees, maintained them and cut them at their own discretion. Otherwise, women have to consult their husband before making tree related decisions. However, women are knowledgeable about the burning characteristics of various species and about species that have food values. Women also use forest products for various purposes, thus have intimate involvement with forest products and agriculture production. Indeed, women who know, what is needed; which trees are suitable and which are not and who will use the final product. Therefore, women's participation is highly required for agroforestry management and yield regulation.

Community role of women

Women have got important influence in formal or, informal association in the community both private and the public spheres. Involvement of women in "mother group" for social work is a classic example of the massage for welfare and ethical society. In addition, women are involved in literacy and cooperative program for the income generating activities for the benefit of the group. Within the domestic sphere, women exercise influence public events through their information link, which are based on linkage tics and on their ability to with, hold goods (foods etc) necessary for man's public participation. Community management activities are extension of women's reproductive role. It is unpaid work, which ensures the continuance and well being of collective community resources, such as water, education and health care.

The care of sick children is essential and demanding community service fulfilled by women. This included not only providing and administrating medicine to ill person but also preparing meals and spending time caring for the ill person. Women also involved in teaching children especially to girls about practical agriculture and cooking skills. In addition, some of the women are very active in social and community work. They may also participate in leadership roles in formal institutions. Therefore, women have to be encouraged to participate actively in agroforestry system.

Why women in agroforestry ?

Fourth World Conference on Women in Beijing, 1995 onwards donors, policy makers and development practitioners have pointed out the critical role of gender in development programs (Doss, 2001; IFAD, 2003; World Bank, 2007; IFPRI, 2007; Peterman et al, 2010; Quisumbing and Pandolfelli 2010 and Meinzen-Dick et al, 2010). In general gender inequalities in ownership and access to resources; land tenure, education, and health care have impact on reduction in agricultural productivity and rise in poverty levels. In fact, gender matters in all aspect of production; particularly women's issues in agricultural production have got affect at large. However, the role of women in the adoption of agroforestry is very crucial.

However, women are not encouraged in the development discourse as expectation due to cultural and socio-economic factors. The participation of women relative to men, highlight gender discrepancies so that strategies that challenge imbalances are addressed, thus ensuring that both men and women are able to make decisions, access resources equitably and benefit from agroforestry (Kiptot, et al 2011). In agroforestry practices gender analysis is required from planting to harvesting trees in order to ensure equitable benefits. It is now well realized that sustainable development cannot achieve without taking women's vital roles into considerations. In the hills women play a very important role in agricultural production. The important role of women in economic development is well depicted

by Boserup, 1970. She has explained central positions of women in the household economy of their societies. Following are the reasons why women should be involved in Agroforestry program.

- Women play a key role in most agricultural production systems.
- Women contribute to protection and management agroforestry species on the farm land.
- Women contribute continuously, but exclusion from the benefits associated.
- If women had access to the same resources (e.g., education, farm inputs and labour) as men, food production would be boosted by 10-20%.
- Despite the key role that woman play, their contribution to agriculture is largely ignored by policy makers.
- Women suffer more from environmental degradation and better knowhow about environmental concerned.
- In practice women are main managers of environmental and natural resources because they are more involved in utilization of natural resources.
- Women are more responsible for care and share in harvesting of field crops and collection of forage and fodder.

From above points it becomes crucial that women must be involved in management and sustain agroforestry system in the hills. Agroforestry as a farming system in which perennial trees and shrubs are deliberately grown on the same land management system as annual crops and/or livestock is a common system of production in the hills. At the centre of this type of farming system are women farmers who are responsible for producing most of the labour. For example, the women provide most of the labour for cutting grass, manure application, feeding animals, milking, fetching water and even selling milk.

Women Empowerment and Social Capital through Agroforestry

In term of social perspective, achievements made by women in agroforestry practice are confidence and self-esteem, which enable women to make informal choices in management and species selection for agroforestry. This made women organizes themselves, discuss their need and problem to find common consensus. It leads to organize women in self help groups and cooperatives for agroforestry based activities, which could empower them socially. This is a step forward in the process of building social institution of 'women working group' to involve in agroforestry. It fosters decision making and action through collective process. The required technical knowledge regarding agroforestry systems may help them in their technological empowerment and can increase their mental horizon. It builds a positive image of women by recognizing their contribution to society and economy. However, it helps to ensure equal participation of women in development discourse. The active participation of women in the development course enriches their ability to think critically, which empowered the women.

The systematic management of agroforestry in the hills increases the productivity of forage and crops, which make the easy availability of food products and could, empower women. The nearby

and easy accessibility of fodder, wood and food products could help to reduce the hard working time period. The opportunity time may be utilized in social institutions to develop leadership quality and improve the social capital. Nonetheless, the regular participation of women in the in the social institutions and programs could help to reduce gender discrimination in the field of agroferestry and development discourse.

Suggestions

After the observation of the present scenario of the agroforestry practice in the hills for empowerment of women and income generation the following suggestions could facilitate to expedite the agroforestry program.

Policy intervention

In order to promote agroforestry extension services ensure the participation of women and deliberate gender sensitive interventions.

- Training to more women extension officer to serve the hill communities and interact more easily with women farmers.
- Organise 'women working group' in agroforestry in the hills and provide significant assistance to them.
- Ensure extension activities address different interest of 'women working group' like the production of vegatables, fruits, fodder, fuel wood, timber and poles.
- Facilitate 'women working group' to access market information. Women farmers can greatly reduce losses if they could get market information about appropriate buyers at appropriate time.
- Encourage the development of rural micro-credit institutions whose regulations are friendly to women and link 'women working group' to these financial institutions.

Technical intervention

Technical intervention for the improvement of the quality and quantity is necessary in agroforestry system in the hills.

- Domestication and expansion of important agroforestry species like Lapsi and Amriso.
- Some of the valuable forest products have to collect from the forest and becoming scare resource, particularly the medicinal plants. Therefore, promotion of participatory domestication of these species i.e. amala, kurilo, into appropriate farming system.
- Develop the technology which is socially, culturally and economically acceptable.
- Development of appropriate storage and processing method for the assurance of marketing, which will increase the income of the women.

Institutional interventions

- Agroforestry products of women in the hills are trapped at the end of value chain. Therefore, the government and private sector need to foster women entrepreneurs and strengthen 'women working group' or link them to market and industry.
- The collective action of 'women working group' would be gain powerful position in the value chain, which would be beneficial to improve bargain power, bulk sales, and reduction in transaction costs.
- Development of new products from agroforestry produce such as essential oil, soap and juices and sustainable supply improve the rural trade.

Conclusions

The systematic development of agroforestry in the hills has strength to organize 'women working group' into functional group. Because the main collectors of fuel and other forest products such as animal fodder and leaf compost are the women together with their children. Besides, women also take primary responsibility for herding family livestock, including cattle, sheep and goats. Therefore, the social strength of women's has been empowered to participate in agroforestry practices and management. This shows that agroforestry offers substantial benefit to rural women in the hills. However, women's participation is very low in agroforesrty based enterprises, because it is considered as the domain of men. Thus, women are confined to the lower end of the value chain in the marketing of agroforestry products, which limits the income from the productive process. To take the women out of this trap, the above suggested various policies, technological and institutional interventions need to be implemented.

In the perspective of agricultural and animal husbandry work women have to engaged more in the hills, because many of households men have migrated to other parts of Nepal or to India in search of employment as casual labor to supplement household income. In this situation, the women in the hills must be engaged in a greater proportion of the agricultural tasks. The promising approaches to improving women's benefits from agroforestry are diversification of agroforestry products and appropriate marketing. The collective action of 'women working group' could help to raise income from agroforestry products.

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ROLE OF WOMEN IN AGROFORESTRY

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Abstract

Agroforestry systems are not new. The only thing new is the use of the term 'agroforestry'. It refers to system of land use which combine growing or raising crops (and/or livestock) with woody plants, i.e. agriculture + animals husbandry + forestry. Women are traditionally the prime participants in both the agricultural and the forestry components of agroforestry production systems. However, men continue to dominate farm decision making, even in areas where women are the longest providers of farm labour. Women become protagonists of agroforestry, improving the living conditions of their families and increasing their participations in the space of productions, marketing and advocacy. Studies have pointed out that women's labour and women's decision making are all solely crucial to agriculture productions and development. Women are primary users of forestry products such as fuel wood, wild fodder and food, where as men are more interested in forest products for commercial sale. Women are more knowledgeable about what is needed; which trees are suitable and which are not and who will use the final products. Women also use products for medicine making, basket making etc. In minor forest products, it is often only women who are involved in agroforestry chores and decisions. It has been thought that women are passive members of communities in which public influence and public actions is a sphere restricted to men. Experience from all over the world show that, women, despite their long and our working schedule, have a great interest in defending and restoring the forest's ecosystem. India's 'Chipko Andolan' is a classic example of women protesting against forest destruction. Protests against deforestation are not the only responses. Women are also leading attempts to reverse the destructions by planting trees. Several movements across the world are being organized for eco-development in which rehabilitation of the ecological balance by tree planting is promoted. Although women's efforts in re-afforestation will not reverse the trends of diminishing resources, they can help to address deeper injustices and in equalities.

Discrimination against women is common in every field. Women workers are paid less than the men. Even in the 'new' approach of social forestry women are excluded. Globally, the number of professional women forests as still very low, but just by increasing their numbers does not automatically mean that their needs and priorities are adequately taken into account; professional women can serve as catalysts for changes.

There are several reasons and case studies to prove that the participation of women is essential for the success of agroforestry project, but such participation may, in long run, also require changes both in approach and in the nature of personnel in forestry and extension departments.

Key words: *agroforestry, women's participation, afforestation, eco-development*

Introduction

In the present sinerio it is hard to believe that not so long ago agroforestry was not a familiar word, let alone a recognized concept. It is a tribute to the vision of many thousands of professionals

during the past quarter century that agroforestry has now achieved such wide recognition as an integrative science and practice with enormous potential to transform lives and landscapes in today's and tomorrow's world. Their hard work and dedications has meant that millions of people around the world now not only know about agroforestry but are also directly benefiting from it.

Agroforestry is an integrated approach of using the interactive benefit from combining trees and shrubs with crop and/or livestock. It combines agricultural and forestry technologies to create more devise, productive, profitable, healthy and sustainable land use system. In agroforestry system, trees and shrubs are intentionally used within agricultural system, or NTFPs are cultured in forest settings. Knowledge, careful selection of species and good management of trees and crops are needed to optimize the production and positive effects within the system to minimize negative competitive effects.

Millions of farmers across the world practice Agroforestry (60-80% of them being women), which has been a feature of Agriculture for millennia. Under this a wide range of working trees are grown on farms and in rural landscapes. Among these are fertilizer trees for land regeneration, soil health and food security, fruit trees for nutrition and income; fodder trees that improve small holder livestock production; timber and fuel wood trees for shelter and energy; medicinal trees to combat disease, particularly where these is no pharmacy; and trees that produce gums, resin or latex products (Garrity, 2004). Many of these trees have multiple uses, each providing a range of benefits.

In India, large- scale Agroforestry in form of Social forestry was promoted in the 1980's and 1990's, thanks to externally aided Social forestry projects complemented by Govt. of India schemes under wastelands and watershed development project. Intensive Agroforestry has certainly created investment and employment opportunities to supplement the on-farm income (Karesmulla *et al*., 2003; Saigal *et al*., 2002).

From being a traditional practice with great potential during the past 30 years, Agroforestry has progressed to the point where it provides an important science – based pathway for achieving important objectives in natural resource management and poverty alleviations. Agroforestry is one of the few productive land users that contribute directly and synergistically to the objectives to all the key international environmental and sustainable development conventions.

Women in Agroforestry

When we think of the rural women, the first image that comes to our mind is of poor women in the rural area carrying loads of fuel wood, working in household, farm, looking after the livestock and many different forestry activities. The principle beneficiaries of agroforestry research are small farmers, the majority of whom are women. Throughout the developing world, women make significant contribution to agroforestry. Many women farmers have been using some of these agroforestry practices, though unconsciously, in their traditional farming methods while other women farmers are not even aware of any of these systems and the immerse benefits they offer.

Rural women in developing countries take up majority of the farm workload. They grow and harvest most of the staple crops that feed their families. Food security throughout the developing world depends primarily on women. Yet they own only a small fraction of the world's farmland and receive less than 10% of agricultural extension delivery. Agroforestry offers many entry points to improve

the status, income and health of women and children. Rainwater harvesting and tree growing on farm reduce the drudgery of fetching water and fuel from distant areas. Because women are in change of household and staple crops, female farmers often fail to gain from export- oriented agriculture. Much more needs to be done to understand the kinds of traditional and non-traditional agroforestry products that are accessible to women, and to get research attention focused on there. This also applies to value- added processing activities and marketing.

Women's participation is very high in enterprises that are considered to be women's domain, such as indigenous fruit and vegetable products and processing. Indigenous fruit and vegetables are attractive to women because they involve minimal inputs in the form of labour, which women can provide. Planting trees have different meaning for men and women. Men are usually interested in trees for commercial purpose while women are more inclined to tree products for subsistence use such as firewood, soil fertility improvement, fodder and fruits. Agroforestry practices for replenishing soil fertility are attractive to women farmers because they involve low inputs but high returns.

Women are frequently responsible for small-stock husbandry and the feeding of larger livestock, particularly milk cows and caves. Thus, agroforestry projects that involve fodder trees, the service of crops by trees, or intercropping of crops and trees must include women, since it is often women who grow the crops or care for the livestock that will be involved.

Women may make different uses of forest products then men. Women collect fuel wood as well as food for both human and animal from forest and individual trees. They are knowledgeable about the burning characteristics of various species and about species that have food values. Both man and women make medicine from forest products for purpose like basket- making and dyeing. Women's intimate involvement with forest products and agriculture production often result in their having a greater knowledge of environmental problem than men. It is totally wrong to assume that only men are involved in forestry. In the case of fuel wood and minor forest product, it is often only women who are involved.

The forest is the source of fuel, fodder, food (mushrooms, leafy vegetables, wild edible fruits, tubers) and income (Sal leaf plates). A majority of the NTFP (sal leaves and seeds, tendu leaves, mahua seeds, fuelwood and wild fruits) gatherers are women.

The challenges faced due to the impact of environmental degradation are not same for men and women. The potential for women's role in areas such as reforestation and soil and water conservation is especially high because they are the principle sufferers from environmental degradation. When the environment is degraded, women's day-to-day activities, such as fuel and water collection, require more time, leaving less time for productive activities. It is they who must walk farther for water, fuel wood and fodder. It is they who must produce subsistence crops on increasingly degraded soils. It is they who often are both able and likely to organize the community for action. Whether we consider women apart or women as a district sub group within the large population, the terms of their participation will usually be district from those of men, owing to difference in rights and responsibilities. This is especially true with regard to the quantity, terms of access to land. The role of women in forest production is usually ignored. Women spend most of their time in forest. It is they who keep a close watch on forests and detect any minor change in them. While the men take on production responsibilities as duties and separate tasks, the women integrate these

with their daily closes. Though women play a major role in production, they do not from a part of the traditional village governance systems.

Role of trees in agroforestry

Trees have always been an important component of the farming system in several parts of India. Trees have a significant role in keeping the environment clean, while supporting livelihoods. Choice of tree species is the key to the success of any afforestation programme. Profitability is the main factor for tree plantation on private lands.

Under Agroforestry, trees serve as wind breaks, source of organic matter, shade and soil binder to prevent soil erosion while generating additional income. Shelterbelt plantation of tall growing trees on field bunds is very popular in India. Species used under this plantation are eucalyptus, poplar, casuarina, bamboo (*Dendrocalamus strictus* and *Bambusa arundinacae*), acacia, dalbergia, leucaena, silver oak (*Grvillea robusta*), sesbania, gliricidia, melia etc. These trees provide poles, foliage, twigs for fodder, fuel and green manure.

Depending on the fertility and depth of soil and moisture availability, different tree species can be introduced. Agri-horti-forestry can be promoted on degraded private lands particularly in hilly terrains for rehabilitation of tribals. Various agricultural crops can be grown as intercrops between the fruit trees, to generate income from the first year itself, while fruit trees start bearing fruit after 4-6 years (Hegde, 2011).

Fast-growing multipurpose tree species (MPTS) are preferred, especially yielding fruit, fodder and mulch and being suitable as supporting structures for the cultivation of pepper, betels and various climbers (Radha & Prasad, 2011).

Fast-growing MPTS produce substantial quantities of biomass within a short period of time. This biomass in the form of fresh foliage, leaf litter and wood meets the fodder, fuel, timber and manure requirements of the rural population. The introduction of MPTS on farmlands enabled communities that had become dependent on nearby forests and common lands for their biomass to grow at least some of it on their own land.

Exotic tree species have found their way into Indian farming systems since long. In dry tropical areas, the traditional practice of farmers has been to plant species like neem and mango within the cropping area, but include the exotics along the fence and on farm bunds. Hence, species such as *Jatropha curcas* and *Prosopis juliflora* are usually found on farm boundaries. Many of the exotic tree species probably entered the local farm scene through plantation agriculture. Because commercial plantations were mostly established in humid tropical areas, the species introduced were generally those adapted to high moisture regimes. In due course, small farmers brought some of these species with adaptation to a wider environmental range to semi-arid areas.

There are some exotic species such as *Eucalyptus tereticornis* and *Acacia auriculiformis* that have gained popularity among farmers in semi-arid areas.

Many tree products that benefit women are collected from wild populations in forests, woodlands/ rangelands, parklands or on farms. With the increase in population, some of the products are becoming scarce and women have to walk longer distances. Promoting participatory domestication

will therefore enable integration of these valuable species into appropriate farming systems. In addition, various technologies that are socially, culturally and economically acceptable will be developed. The results of such an initiative will be appropriate propagation methods, cultivars that meet a range of market requirements such as fruit with specific size, taste, and maturity periods so that farmers, especially women, can have a year round flow of cash from agroforestry products.

Types Of Agroforestry Systems

Main agroforestry systems in the country include poplar based commercial agroforestry in Punjab, Haryana, Himachal Pradesh and Western Uttar Pradesh, coffee plantations in Karnataka and Tamil Nadu, tea cultivation in Assam, Sikkim, Himachal Pradesh and Tamil Nadu, and woodlot in southern states, including Karnataka.

I) Agrosilvicultural Systems

In this system, agricultural crops are the major component of the land-use system and are intercropped with tree crops in the interspaces between the trees.

Eg. *Prosopis cineraria*, Grewia optiva and other tree species, Acacia spp, Eucalyptus spp, *Leucaena leucocephala*, other tree species, Woodlots.

II) Silvoagriculture Systems

Here trees are the major component of the land-use system and an agricultural crop is combined with them, e.g. Coconut, Arecanut and Poplars are combined with horticulture system.

III) Silvopastoral Systems

In this system trees are combined with grasses. The trees and shrubs may be used primarily to produce fodder for livestock or they may be grown for timber, fuelwood, and fruit or to improve the soil.

Acacia nilotica, Albizia lebbeck, Azadirachta indica, Leucaena leucocephala, Gliricidia sepium, Sesbania grandiflora, Gliricidia sepium, Sesbania grandiflora, Erythrina sp, Acacia sp., Acacia nilotica, Acacia leucophloea, Tamarindus indica, Azadirachta indica.

IV) Agrosilvopastoral Systems

Here the woody perennials are combined with annuals and pastures.

This system is sub-divided into two categories:

a. Homegardens

b. Woody hedgerows for browse, mulch, green manure and soil conservation

a. Home gardens

This system is found extensively in high rainfall areas in tropical South and South east Asia. This practice finds expression in the states of Kerala and Tamil Nadu with humid tropical climates where

coconut is the main crop. Many species of trees, bushes, vegetables and other herbaceous plants are grown in dense and in random or spatial and temporal arrangements. Most home gardens also support a variety of animals. Fodder grass and legumes are also grown to meet the fodder requirement of cattle. In India, every homestead has around 0.20 to 0.50 ha land for personal production.

Home gardens represent land use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and livestock within the compounds of individual houses. Components like animal husbandry, aquaculture, sericulture, apiculture etc. are included for the purpose of meeting the home needs and also to generate additional income. Home gardens can also be called as **Multitier system** or **Multitier cropping.**

Home gardens are highly productive, sustainable and very practicable. Food production is primary function of most home gardens.

Choice of species:

a) Woody species: *Anacardium occidentale*, *Artocarpus heterophyllus*, *Citrus* spp, *Psidium guajava*, *Mangifera indica*, *Azadirachta indica*, *Cocus nucifera*, Spices.

b) Herbaceous species: Bhendi, Onion, cabbage, Pumpkin, Sweet potato, Banana, Beans, etc.

b. Woody Hedgerows:

In this system various woody hedges, especially fast growing and coppicing fodder shrubs and trees are planted for the purpose of browse, mulch, green manure, soil conservation etc. The following species viz., *Erythrina sp, Leucaena luecocephala, Sesbania grandiflora* are generally used.

Benefits Of Agroforestry System

A) Environmental benefits

1. Reduction of pressure on natural forests.
2. More efficient recycling of nutrients by deep rooted trees on the site
3. Better protection of ecological systems
4. Reduction of surface run-off, nutrient leaching and soil erosion through impeding effect of tree roots and stems on these processes
5. Improvement of microclimate, such as lowering of soil surface temperature and reduction of evaporation of soil moisture through a combination of mulching and shading
6. Increment in soil nutrients through addition and decomposition of litterfall.
7. Improvement of soil structure through the constant addition of organic matter from decomposed litter.

B) Economic benefits

1. Increment in outputs of food, fuelwood, fodder, fertiliser and timber;
2. Reduction in incidence of total crop failure, which is common to single cropping or monoculture systems
3. Increase in levels of farm income due to improved and sustained productivity

C) Social benefits

1. Improvement in rural living standards from sustained employment and higher income.
2. Improvement in nutrition and health due to increased quality and diversity of food outputs.
3. Stabilization and improvement of communities through elimination of the need to shift sites of farm activities.

Some of the Prominent Agroforestry Systems in India

1. Plantation crops, such as poplar based commercial agroforestry in Punjab, Haryana, Himachal Pradesh and Western Uttar Pradesh
2. Large cardamom & alder plantation in Arunachal Pradesh, Sikkim, Meghalaya and Upper Assam.
3. Trees on farm boundaries across the landscape in the country.
4. Shrubs and trees on Rangelands, especially in Rajasthan, Maharashtra and Gujarat.
5. Shifting cultivation in North Eastern States of the country.
6. Fruit orchards, especially mango, guava, sapota, pomegranate and oranges across many states in the country, and apple, peach, plum and apricot in sub- temperate climates.
7. Tea in Assam, Sikkim, West Bengal, Himachal Pradesh and Tamil Nadu; Coffee in Karnataka and Tamil Nadu.
8. Woodlots in Central India, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Karnataka
9. Inter-spread trees on farm lands, all over the country, especially in tribal areas of Jharkhand, Chhattisgarh, Odisha and West Bengal
11. Coconut, arecanut, black pepper, cardamom, cinnamon and other spices in the home gardens, especially in Kerala, Tamil Nadu, Odisha and Assam.
10. Aqua -forestry in Kerala, West Bengal and Odisha
12. On- farm tree and shrub fodder production for dairy and meat based livestock systems, especially in sub- temperate and semi-arid and arid regions.

13. Taungya cultivation in the Eastern and North Eastern States of the country.

14. Shelter Belts along the coast line, particularly in Odisha and Tamil Nadu.

15. Apiculture throughout all areas in the country (http://www.nac.nic.in/pdf/recommendations_agroforestry.pdf)

Policies and programmes related to Agroforestry in India

Even if an agroforestry system is ecologically harmonious and socially beneficial, it will fail unless it meets two more criteria: favorable economics, and favorable policy. Appropriate policy is the final condition necessary for agroforestry to succeed (Sanchez, 1995). Perhaps the most important policy consideration is *land tenure* (Nhantumbo, 1999): who owns the land ? Who owns the trees ? What are their rights ? Farmers will only be willing to work hard to improve the land if they know their investment will be protected. Even something as simple as fencing – which can be very hard to come by in rural areas – can make a huge difference to the success of an agroforestry program (Schroeder, 1999).

Currently there is no specific scheme in India to promote agroforestry and it lies within the domain of state governments. A National Agroforestry Policy is being called for in India to help coordinate activities among stakeholders and take agroforestry to a 'higher level'.

According to the National Food Security Act, 2013, the Government is legally obliged to provide about 62 - 65 million metric tons of food grain (primarily rice and wheat) annually to the Public Distribution System. Procurement by government agencies ranges around 30 -33 percent of production. In 2012-13 production of wheat and rice was of the order of 197 million metric tons. This implies that agroforestry systems that promote crop production and productivity should be given priority.

The role of agroforestry has been emphasized by major policy initiatives including National Forest Policy 1952, 1988 and the National Agriculture Policy 2000, Planning Commission Task Force on Greening India 2001, National Bamboo Mission 2002, National Policy on Farmers, 2007 and Green India Mission 2010, for efficient nutrient cycling, organic matter addition for sustainable agriculture and for improving vegetation cover. The National Agriculture Policy, (2000) stresses that, "farmers will be encouraged to take up farm/agroforestry for higher income generation by evolving technology, extension and credit support packages and removing constraints to development of agroforestry"

Yet, there is no specific scheme to promote agroforestry in the country although, there are a number of schemes of Government of India in which agroforestry is recognized as an important component. To mention some of them, Integrated Watershed Management Programme, Mahatma Gandhi NREGA, (Ministry of Rural Development), Soil Conservation in the Catchment of River Valleys and Flood Prone Rivers, National Horticulture Mission, Sustainable Agriculture Mission (Ministry of Agriculture); National Mission for Green India (Ministry of Environment & Forest), etc.

Constraints inhibiting growth of Agroforestry in India

There are many constraints, ranging from unfavourable legal provisions for felling and transportation of trees planted on farmland to near non-existent extension mechanisms on agroforestry, lack of institutional mechanisms at all levels to promote AF, lack of quality planting materials, inadequate research on agroforestry models suitable across various ecological regions of the country, inadequate marketing infrastructure and price discovery mechanisms, lack of post- harvest processing technologies, etc. Since the mandate of the agroforestry falls within the cracks of the various ministries and departments and state governments, there is no serious institutional effort to remove the hurdles mentioned above. The value and position of agroforestry in the national system is ambiguous and undervalued. Despite of numerous benefits, in the national system it is sporadically mentioned here and there because of the lack of a national policy.

Absence of a national policy and a suitable institutional mechanism

It is estimated that on average nearly Rs. 4000 crores or more is being spent annually on tree planting / agroforestry through a number of Centrally Sponsored Schemes. While there are many schemes trying to focus on tree planting / agroforestry, there is an absence of a holistic vision and focus, and lack of an institutional mechanism for coordination and convergence among the schemes/ Ministries to pursue agroforestry in a systematic manner.

Lack of an integrated farming systems approach

Farming enterprise of small farmers needs to be understood and developed as a portfolio of activities rather than as "fixed one type of cropping system". Development along this direction requires a convergent programme which integrates tree, crops, water, livestock and other livelihood initiatives. This perspective of integration seems to be missing in the national agroforestry initiatives in whatever form it may currently be.

Inadequate attempts at liberalization of restrictive regulations

There are sporadic examples of States taking steps for liberalization of these restrictions, such as, exempting agroforestry species from the felling and transit, but this has not been uniformly done by all the States. Also the extent of liberalization is not widely known to the farmers and thus, their exploitation continues. It is also learnt that farmers do not take interest in tree planting on the farm land fearing that too many trees on farm may lead to change of land-use. Clearly such apprehension has no basis; however this does emphasize the lack of awareness that persists on the ground.

Insufficient research, extension and capacity building

Research results of agroforestry available in the public and private domain did not reach the farmers due to lack of a dedicated extension system. There is a serious lack of institutional mechanisms at all levels to promote agroforestry. The efforts to dovetail the programme to any other established programmes which have strong institutional mechanism up to the implementation level, such as the

Integrated Watershed Management Programme is non-existent. Also, there is not enough research on the agroforestry models suitable for the diverse agro-climatic regions; for the endemic and multi use species (viz. Prosopis cineraria), resulting in popularization of few species (poplar, eucalyptus, Kadam, etc.) and their limited varieties in certain pockets of the country. It is also important to note that India lacks processing technologies for fast growing timber species.

Dearth of quality planting material

The planting material such as seeds, seedlings, clones, hybrids, improved varieties, etc. are generally of mix quality and not available commonly, particularly in the resource poor regions. It is estimated that out of 20 crore saplings required for planting every year, only about two crore are produced in the nurseries which are reliable under certain quality parameters, the rest go without any guarantee for quality standards. Hence, there are major issues related to the production of quality planting materials, handling, distribution and finally planting and supervision.

Weak market accesses for agroforestry produce

The marketing infrastructure (market yard, etc.), including "price discovery" mechanisms for agroforestry produce in general are unavailable in the country except in few states which have either developed exclusive marketing infrastructure for agroforestry produce or have dovetailed with the regulated agriculture commodity marketing systems. As a result, it is largely a buyer's market and the middlemen get the major share in profit. Many a times to avoid cumbersome procedures to obtain felling and transit permit the producers sell their standing crop to the middlemen at throwaway price who in turn in connivance with the government functionaries manage the official procedures to take the produce to the market.

It could be summarized that although farmers are interested to expand agroforestry, as the evidence on adoption shows, there are many missed opportunities for agroforestry to benefit farmer income and the environment due to neglect /oversight of the agencies that are supposed and expected to adequately promote and support it.

Key Elements of a National Policy on Agroforestry

In a scenario of decreasing availability of arable land for agriculture, degradation of soil and depletion of water resources, increasing pollution hazards and threats to the environment and eco-system from global warming and climate change, new approaches in farming systems are needed to meet the demands of a growing population for food, fodder, firewood and timber. Agroforestry interventions in already existing land-use systems have the potential to achieve simultaneously

(i) Increase crop production and productivity

(ii) Protect and stabilize the ecosystems and

(iii) Improve livelihoods of rural households.

It is time that agroforestry takes its rightful place with other agriculture enterprises. While its benefits have been demonstrated and its potential has been recognized to enable its widespread

impact to be felt, there is need to enunciate a National Policy on Agroforestry to confer on agroforestry the importance it deserves.

A common belief is that introducing trees into fields will negatively affect the growth of agricultural crops. However, in northwestern India extensive integration of rows of poplar trees into wheat and barley farms by smallholders significantly increased income without any loss of crop production. The general perception of agroforestry is that of an activity peripheral to agriculture and other forms of land use and farmers engaged in it may be seen as inferior and old fashioned, compared with those practicing monoculture.

Unclear status of land and tree resources

Unsecured or ambiguous land tenure, common in developing countries, results in confusion about land delineation and rights. Rights to trees may be separate from rights to land and both land and tree tenure insecurity may discourage people from introducing or continuing agroforestry practices. In many places, lack of long-term rights to land inhibits long-term investments such as agroforestry. When the rights to land are not clearly stated by law, the absence of legal recognition makes any other measures ineffective. This can manifest itself as a conflict of interest between the state and land users, especially where state ownership of land appears to be the main inhibitor of action. There are various types of tenure insecurity. In many cases, tenant farmers, especially migrants, do not plant or manage trees because tree products belong to the owner. If people do not have title to land, there is a perception that there is no point in investing in trees, which can take a long time for benefits to be realized. Competing claims of tenure rights, such as seasonal rights to communal grazing can jeopardize the protection of trees. Moreover, recent attempts by some governments to attract large-scale foreign investors have heightened the insecurity of rural communities. In some cases, forest regulations inhibit tree growing on farms by restricting the harvesting, cutting or selling of tree products and certain tree species or forest services may control the management and harvesting of trees through permits so that farmers who introduce trees into fields are not free to manage the tree products as they wish. In turn, the permits may be difficult to obtain because of bureaucracy, or harvesting may be forbidden altogether. Although sometimes well intentioned, such protective measures, when applied to agricultural landscapes, discourage farmers from planting and protecting new seedlings that emerge. As far as land tenure is concerned, there are some constraints that are common to most developing countries. In both legal and customary practice, women and other vulnerable groups, who may need to grow more food (and thus to develop agroforestry), have limited access to land and resources. Therefore developing private property through tenure laws may create a gender imbalance in land ownership, calling for more innovative approaches. Adverse regulations, multiple legal restrictions on multifunctional land management and complicated taxation frameworks also restrict agroforestry development. Frequently the agricultural policy itself penalizes practices needed to implement agroforestry, while supporting a large-volume, large-scale approach to agricultural, food and fuel products. Taxes applied to agricultural production may penalize agroforestry practices, a Lack of coordination between sectors As an intervention affecting multiple sectors – including agriculture, forestry, livestock, rural development, environment, energy, health, water and commerce – agroforestry is often subject to policy conflicts and omissions, creating gaps or adverse incentives that work against its development. In addition, when policies are restricted to exclusively sectoral bureaucratic regulations, mistrust between farmers and decision-makers is the result. In many countries, in

principle, agroforestry is regarded as belonging to 'all sectors', but in practice, it belongs to none and rarely occupies a special line in a governmental body or has its own policy space. It falls between the agriculture, forestry and environment departments, with no institution taking a lead role in the advancement of agroforestry or its integration. Agriculture departments emphasize crop production on agricultural lands; thus agricultural policies directly contribute to excluding trees from farms and the landscape. Some forestry departments do not believe it is possible to grow good quality, widely-spaced timber on farms and have little interest in non-timber trees or the growing of trees with crops and/or livestock on the same plot of land. Yet, forestry departments are usually mandated to multiply and disseminate all types of tree germplasm. Moreover, environment departments may dislike regulated rows, intensive management and chemical control of weeds in conclusion; the harmonization and synchronization of policies and programmes require a combination of policy attention across the departments in charge of rural development, land use, agriculture, forestry, environment, finance and commerce, at both national and local level.

Agroforestry systems prove successful and sustainable only when they have direct benefits for farmers. There is no agroforestry success story if incomes decrease considerably, even if only for a temporary initial phase. In most situations, farmers may not be willing to wait out a lengthy investment phase before realizing revenues. Strategies to fill the initial gap are often necessary to the adoption of agroforestry systems. Generally speaking, if trees are to be introduced into existing cultivated fields or pastures, short- term income is maintained by introducing low tree densities while intensifying agricultural practices. After some time, the tree products and services will boost income with the aim of raising overall system productivity. If there is a clear risk of decreasing short-term revenues, although important social and environmental benefits are expected in the long run, policies should aim to create a beneficial context for farmers introducing trees. For example, it is possible to design agroforestry systems where a temporal sequence of different crops ensures that some annual commodities are harvested at all stages of tree development (for example, light demanding crops while trees are still small, and more shade-tolerant crops at a later stage).The importance of economic considerations partly explains why most success stories in agroforestry development did not involve significant inputs from governmental agencies. In fact the private sector has played a significant role in creating awareness of agroforestry and supplying seedlings although this may create a culture of dependency. Security of tenure rights is important More than in other agricultural systems; trees on farm require stability and security of tenure rights. This is a significant issue in many developing countries. Due to the longer period relative to annual crops – through which farmers' testing, adaptation and eventual adoption of agroforestry technologies takes place – the importance of property rights is greater than in many other types of agricultural enterprises and practices. A clear guarantee of tenure rights can support a farmer's strategy to invest in trees on farms, including in cropland. Only then can farmers – as investors – make plans with the confidence that the parameters shaping their long-term vision will not change. There are few agroforestry success stories in an uncertain land tenure context.

Agroforestry systems are of multifunctional value. In India and other developing countries the path to sustainable development could be a decentralized planning and implementation of strategies that promote local biomass production in agroforestry systems. Such decentralized systems in India can provide critical inputs for livelihoods improvement and sustainable development. Along with mitigating the climate change agroforestry systems can at least partially meet the energy needs of 1 billion people in India through bioenergy options by a prudent use of agricultural residues and

biomass generated in agroforestry systems. Biomass energy-based supply options can create rural wealth and employment necessary for livelihoods improvement and sequester large amount of carbon in a decentralized manner. Such a strategy would also ensure ecological, economic and social well-being. Thus, energy and food self-sufficient taluka (a small administrative unit) can be a new model of rural development in India 1n conclusion, in order to use agroforestry systems as an important option for livelihoods improvement, climate change mitigation and adaptation, and sustainable development in India, research, policy and practice will have to progress towards: (i) effective communication with people in order to enhance the agroforestry practices with primacy to multifunctional values; (ii) maintenance of the traditional agroforestry systems and strategic creation of new systems; (iii) enhancing the size and diversity of agroforestry systems by selectively growing trees more useful for livelihoods improvement; (iv) designing context-specific silvicultural and farming systems to optimize food production, carbon sequestration, biodiversity conservation; (v) maintaining a continuous cycle of regeneration-harvest-regeneration as well as locking the wood in non-emitting uses such as woodcarving and durable furniture; (vi) participatory domestication of useful fruit tree species currently growing in the wilderness to provide more options for livelihoods improvement; (vii) strengthening the markets for non-timber forest products, (vii) and addressing the research needs and policy for linking knowledge to action. Prevalence of a variety of traditional agroforestry systems in India offers opportunity worth reconsidering for carbon sequestration, livelihoods improvement, biodiversity conservation, soil fertility enhancement, and poverty reduction

Success Stories From India

West Bengal

Eco-conservation is the keyword for women in Sundarbans

By collectively managing trees on common land, women in India are receiving multiple benefits and helping mitigate and adapt to climate change. The women belong to the Nivedita Self Help Group and have fought hard to manage a green stretch of land along the Gobadia River in South 24 Parganas district of West Bengal as a common property resource. The district encompasses the UNESCO World Heritage Sundarbans mangrove forest. A total of 4,000 trees have been planted by the women that include 31 different varieties such as coconut, *neem* which has medicinal and insecticidal properties, *sundari* (a mangrove species) and minjiri.

The project was initiated by the NGO, Development Research Communication and Services Centre (DRCSC), which works with rural poor to implement sustainable management projects. Among these are initiatives to encourage local communities to identify unused land that can be leased or rented for activities such as agroforestry to supply food, conserve biodiversity, control erosion and sequester carbon.

Previously the women collected fuel wood from the forest where they were at risk from tigers, but now they collect and share the timber harvested from the communal land. They also get fodder for their cattle from the trees and food for their families. Their activities are helping to build resilience to the impacts of climate change. The project has empowered the women to liaise with panchayats (governing elders) and participate in group discussions with villagers on social, financial and

environmental matters. The women in Sunderbans are now participating in group discussions with villagers on matters of social, financial and environmental significance.

Tamil Nadu

A rapid growth in agroforestry and farm forestry has been recorded in the Indian region of Coimbatore.

The Hindu reported on a study by the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore which found government initiatives, water shortages and demand for timber from wood-based industries and a new bio-energy project had all contributed to the increased uptake of agroforestry. Various factors contributed for the farmers taking up tree breeding in farm lands, the study revealed. One among them was the State government's initiative 'Tree Cultivation in Private Patta Lands'.This programme also motivated the farmers to raise commercial timber tree species in their farm lands. Among the species being grown for timber, pulpwood, plywood, veneer and furniture are casuarina, eucalyptus, bamboo, malai vembu, kumil, teak, kadamba and peru. The study further showed that the farmers were growing the timber species by adopting intercrop method. The trees were raised along with agricultural crops such as brinjal, onion, cotton, turmeric, tapioca, groundnut and a host of pulses. While the inter crops could be harvested within a short period of time, the timber species could be harvested within a few years.

The study also showed that in the last three years, on an average, 5,000ha of farm lands in the State were used for tree cultivation. Over exploitation of groundwater led to scarcity, forcing the farmers to take up tree cultivation in their lands rather than raising commercial crops such as paddy or sugarcane. As far as tree cultivation was concerned, the farmers could create small ponds within their lands that could help them to meet out the water requirement for raising the trees. Adopting such a practice would help the farmer at the same time reduce water consumption (The Hindu, 2013).

Gujarat

Since the 1970s, the state has encouraged the planting of trees on farms, wastelands, roadsides, canals, schools and other government lands. The initiatives have seen Gujarat move from being a food deficit to a food surplus state. The social forestry program has been aimed at improving tree resources, increasing green cover and providing timber, fuel wood and fodder to complement supplies from forest areas. The more recent incorporation of agroforestry has focused on producing high quality seedlings than can be supplied to farmers. In the district of Anand, access to irrigation has seen agroforestry flourish. Agroforestry has become one of the main economic activities for farmers in the district who sell timber from the trees. Anand now has the highest density of trees in non-forest areas in India.

The government of Gujarat is now looking to innovations and technologies that can further increase the productivity of agroforestry in the state so that both the rural economy and environment can benefit.

Uttar Pradesh

After creation of Uttarakhand state in the year 2000, the tree cover in Uttar Pradesh has reduced to only 4.46% where as, the State Forest Policy 1998 envisaged that one third of the total geographical area should come under forest/tree cover. Hence, agro forestry is now the only option to increase the desired tree cover of 33%. In Uttar Pradesh, practices of agro forestry vary considerably according to the agro climatic zones, socioeconomic conditions and site-specific tree species.

Across Haryana, Uttarakhand and Uttar Pradesh states, around 750,000 hectares of land are being used for agroforestry, with trees planted alongside crops such as rice. The Centre hopes to have 12 to 15 million hectares of land across India under agroforestry systems in the next decade. India only has about 20 per cent forest cover, largely caused by deforestation due to increasing development.

Higher returns for trees over sugarcane are seeing farmers in the northern Indian state of Uttar Pradesh make the switch to agroforestry. Farmers are now planting primarily poplar trees to supplement their incomes. Where water availability is less, guava and mango are favored species. Because of the narrow crown of poplar trees, wheat and sugarcane can be intercropped.

The benefits of agro forestry is better understood by the farmers in western region of the state, this may be attributed, to the assured market of agroforestry produce because of flourishing wood based industries in the region. Eucalyptus and Poplar are preferred species in the western region, whereas, Shisham and Teak is preferred species in eastern region. Fruit trees also have considerable share of agro forestry particularly in western part of the state.

Haryana & Punjab

The mini boom in agroforestry began in 1996, after the Supreme Court slapped a blanket ban on green felling to save the fast-depleting forests in the North-eastern states, Himachal Pradesh and Jammu and Kashmir. It shifted the wood market to Haryana, Punjab and Uttar Pradesh.

After this, trees started moving to farmland. Till then trees marked the boundary of paddy fields or acted as a windshield to protect cereal crops. The scattered blocks of trees standing tall near the paddy fields in the hinterland of cities like Karnal, Ludhiana, Ferozepur, Amritsar, Bathinda, Ambala, and Kurukshetra tell the story. The shift has entirely changed the landscape in districts like Hoshiarpur (Punjab) and Yamunanagar (Haryana) where 70-80% farmers are fully engaged in agroforestry.

Breaking away from crops like wheat and paddy, farmers opted for cloned poplars and eucalyptuses a decade ago. For farmers in Haryana and Punjab, the move has proved to be a jackpot, thanks to the price rise spurred by the growing demand for wood. Farmers are taking to agroforestry as small-term (three-four years) and long-term (six-seven years) investment options in Haryana and Punjab. With cloned varieties of eucalyptuses and poplars growing almost 25% taller than the ordinary ones, farmers have the option of harvesting trees from the third year. "In the third year trees can be used as poles for construction purposes, filler material in plywood and as pulp in paper-making industry.

And that has resulted in a happy anomaly in the grain bowls of Punjab and Haryana. These states now hold 30-40% of the plywood market and are home to an expanding base of wood-related

businesses like paper-making and furniture. Major plywood brands like Century, Greenply and Venus are expanding in the region. With the price of wood on an upswing in recent years, farmers have not been enticed by the increase in minimum support price for cereals. "Remuneration from agroforestry far exceeds that from traditional crops. Also, the rising input costs of the latter and shortage of labour play out in favour of growing trees.

In the last decade, the flexibility of inter-cropping drove many marginal farmers into agroforestry, a domain of big farmers. In the first two years, farmers got normal yields from crops like wheat, sugarcane and maize planted along the trees. Farmers are growing vegetables and sugarcane as intercrops to see them through the first two years of agroforestry.

With increasing demand for timber and plywood for the construction and paper-making industries, the trees grown under agroforestry systems can be harvested as young as 3 years for poles, filler material in plywood and as pulp in paper making. Crops such as wheat and maize can be intercropped with the trees when they are young or the trees rotated with other crops.

While there was some initial reluctance amongst farmers to take up agroforestry due to the time-lag before harvest, between 70 and 80 per cent of farmers in Hoshiarpur district alone are now involved in agroforestry (Kate Langford, 2013).

Nagaland

The introduction of agroforestry in the state of Nagaland in northeast India is providing economic benefits to local people. the Integrated Watershed Management Programme (IWMP), Agro -Forestry (Fallow Management) and Rubber Plantation Development programs that have improved the livelihoods of those living in around 80 villagers in Dimapur district. The programs have increased the productivity of farmers' land, created employment opportunities and enhanced rural incomes and living standards, says the article. There has also been a reduction in migration away from rural areas to cities.

The success of the programs has been partially attributed to the active involvement of villagers such as through village councils, village development boards and self-help groups (SHGs).

The IWMP has as a central aim, restoration of the natural resource base through activities that prevent soil erosion, regenerative native vegetation, harvest rainwater and recharge groundwater. This has allowed for multi-cropping and a diversity of agro-based activities to be adopted by villagers. Training has been provided in agroforestry, livestock production and disease management. The establishment of micro-enterprises has also been supported through financial assistance provided by the program.

Kerala

A large population in Kerala lives in villages and depends on agriculture for livelihood. The size of the farm holding is very small due to high density of population. The farmers of the state usually under take intensive farming involving a variety of crops on the limited land available in order to obtain food, fodder, fuel, timber and cash from the homesteads. The homesteads present excellent

examples of the basic concepts of agroforestry home gardens. Coconut palm is an important component of these home gardens.

The farmers there undertake cultivation of an array of crops – tree crops, plantation crops, seasonals and biennials – all in intimate mixtures on the same piece of land around the homesteads. Farm animals and poultry and sometimes fisheries also are essential components of the system. The close association of agricultural crops, tree crops and animals in the homesteads represents an excellent example of sustainable and productive agroforestry homegardens. Optimum utilization of available resources of land, solar energy and technological inputs and an efficient recycling of farm wastes are important characteristics of the systems.

Uttarakhand

Women, especially in the hill regions spend a lot of time and energy in procuring fodder for their livestock and fuelwood. To reduce their drudgery, G.B. Pant Institute of Himalayan Environment and Development promoted fodder banks. Mahila Mangal Dals in Garhwal region have been strengthened to help women make decisions in forest use (Misra *et al.*, 2011)

The locals dwelling in higher Himalayan valleys of India (Niti, Mana, Gangotri, Bhyundhar, Yamunotri etc.) of Uttarakhand also prefer horticulture trees like Apple, Plum, Aadoo, Hippophae for their agroforestry systems along with their medicinal crops to maximize their benefits from their meagre landholdings.

Conclusion

Agroforestry can, in many cases, contribute to solving the fuelwood crisis by providing benefits which straightforward forestry or farmwood lots cannot provide, and thereby making it attractive to individual farmers, as well as communities, to plant trees. Development workers must recognize first that farmers, in most countries, have nearly always practised agro-forestry in the fields, as well as around the homestead, until extension and development workers insisted on the advantages of single-cropping on each plot of land.

Farmers' knowledge, and particularly women's, is usually much extended in this area, which provides both food and fuel of direct regular use in the household. Women play a very important role in development. If they are made aware of the rules, regulations and their right they can stand off the most difficult situations. But it is very importunate enough that the women still face the brunt of male dominance and their effort in conservation is ignored. They still have no legal recognition of their conservation and production efforts. The best part why the women are successful in their role as protectionist and conservationist is because they do not feel it is a task but feel that it is part of their daily routine. This quality of women must be saluted and must be given due and much needed recognition.

Trees are a medium for long- term investment on the farm. Thus, the propensity to cultivate them is particularly sensitive to property right. Policy research in agroforestry must continue to strengthen our understanding of these linkages. We need to assist in identifying the means by which women's

land right can be made more secure to enhance the intensification of farming in general and the acceleration of tree cultivations in particular.

India is hosting the **Third World Congress on Agroforestry** in February 2014 at New Delhi. The first two were held in the US (2004) and in Kenya (2009). It might be appropriate if the Government could consider announcing the National Policy on Agroforestry to coincide with the World Congress. India would be the first among the developing countries to have taken this initiative (Deccan Herald, 2013).

In general, agro-forestry practices will prove attractive indeed to farmers and governments alike, provided the mix of elements proposed include the production of at least one high-value product (quality timber, fruit, nuts, etc...)

FLOWER SEED PRODUCTION FOR REMUNERATIVE RETURNS UNDER POPLAR BASED AGROFORESTRY SYSTEM

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Abstract

Low returns from traditional crops, over exploitation of natural resources and the ever-increasing demand for fuel, fodder and timber are the main reasons that compel farmers to integrate trees into the farmland. Poplar tree based agroforestry is emerging as one of the diversification options for the farmers in irrigated agro-ecosystem in north western states of India because a highly lucrative market for its timber is readily available. To make the poplar (Populus deltoides) based agroforestry systems economically more profitable, twelve winter flower annuals were evaluated in comparison to traditional wheat crop. Results of the study revealed that yield and other parameters of flowering annuals and wheat crop were comparatively low in association with poplar than in open environmental condition. Flowering annuals like Coreopsis tinctoria, Coreopsis lanceolata, Phlox drumondii and Gaillardia pulchelia showed better performance than the other flowering annual crops in both the conditions. Study showed that flower seed production of these species under poplar canopy is quite remunerative than growing traditional wheat crop. The tree growth performance was also found better under agroforestry plantation than without intercropping. The system also increased organic carbon content in soil and stored a large proportion of carbon in trees, which may be helpful for additional earnings for the farmers through carbon marketing.

Key words: *Poplar, flowering annuals, wheat, intercropping, goods and services*

Introduction

Agriculture is the dominant land use in Punjab state (India) with over 84% of land under intensive cultivation. Diversification in agriculture in general and rice-wheat rotation in particular has strongly been advocated in irrigated agro-ecosystem to conserve the natural resources. The traditional crop rotation is also loosing profitability but still followed due to assured minimum support price (MSP). Agroforestry, one of the important alternatives for diversification is gaining importance for higher productivity and economic gains. Agroforestry is a dynamic, ecologically sound, natural resource conserving practice rather than resource depleting system. However, farmers are adopting the practice because of enhanced market demands of plywood, paper and furniture units for farm grown timber. Punjab and adjoining states are expanding base for the wood based business and

major brands in the country (Century, Greenply, Venus, kitply, Kamdhenu, etc.) have started their units in the region. With the upswinging of wood prices in recent years and friendly onfarm timber trade policies, farmers are now not much attracted for MSP for cereals but even shifted from boundary plantation to block timber tree plantations. Income from agroforestry produce has far exceeded from traditional crops thus increasing enthusiasm among farmers to adopt agroforestry interventions.

Poplar based agroforestry system is one of the viable alternative land use system to prevent further degradation and obtain biological production on sustainable basis. This system has already been adopted on large scale by the farmers in Punjab and adjoining states. This system provides various products, which contribute to commercial and subsistence agricultural productivity as well as to farm family livelihood. Intercropping of poplar with compatible seasonal crops is essential not only for generating continuous supplementary income but also for creating on-farm employment. There is loss of agricultural production arising from the transfer of land to tree plantations but poplar being deciduous in nature has little affect on the winter crops and normally wheat is grown during winter season. There is extensive loss of agricultural production during *kharif* season, which resultantly can reduce area under rice cultivation through adoption of poplar based agroforestry system.

The flexibility in intercropping has even generated interest among small and marginal farmers into low volume high value crop based agroforestry. During winter months, flower seed production seems one of the viable options to explore, which has a great export potential and north Indian climatic conditions are favourable for their cultivation (Singh *et al.,* 2009). The fluctuating market prices of poplar also demand commercial intercropping for economic security. Flower seed production provides more income than traditional crop rotation and has great future prospect in the time to come in global market. The state of Punjab is highly suitable for flower seed production. The winter season climate match the summer season climate of European countries, therefore, most of crops suitable for those countries are successfully grown in Punjab during winter months and farmers have reported 2.5 to 3 times more profit than wheat. At present approximately 1000 acre area in the state is under flower seed production (Chawla, 2004) but their intercropping under agroforestry system requires interaction and economic evaluation.

Cultivation of flowers for seed production under tree canopy can be of great significance if suitable crops are selected. There are few species (*Gaillardia pulchella, Dianthus barbatus, Calendula officinalis, Gamolepis elegans, Phlox drumondii, Verbena hybrida, Coreopsis lanceolata, Coreopsis tinctoria, Chrysanthemum multicaul, Petunia hybrida, Dimorphotheca aurantiaca, Helichrysum bracteatum, etc.*) for which the prevailing high temperature is not conducive and they require

partial shade for proper seed production , maturity and viability. Such species can be evaluated for seed production potential under agroforestry systems.

Materials And Methods

The study was conducted for three years at the experimental area of the Department of Forestry and Natural Resources, College of Agriculture, Punjab Agricultural University, Ludhiana (30°-54' latitude and 75°-61'longitude, 247 m above sea level) which represent the central agro-climatic zone of the state. The climate in this region is subtropical to tropical with a long dry season from late September to early June and a wet season from July to early September with hot desiccating winds in summer (May-June) and severe cold in winter with occasional ground frost (December-January). The experimental site on an average receives 700 mm rainfall during July-September and a few occasional showers during winters. During this period, temperature fluctuates around 29.9° C. The experiments were conducted in a split-split plot design [main plot: age of poplar trees; sub plot: conditions of cultivation (under poplar canopy and open condition); sub-sub plot: flowering annuals] with a plot size of 2 x 4 m in four replications of 4 x 4 m tree spacing. Twelve winter flowering annuals (Gaillardia pulchelia, Dianthus barbatus, Calendula officinalis, Gamolepis elegans, Phlox drumondii, Verbena hybrida, Coreopsis lanceolata, C. tinctoria, Chrysanthemum multicaul, Petunia hybrida, Dimorphotheca aurantiaca and Helichrysum bracteatum) were raised under poplar canopy (3, 4 and 5 year old) and in the open. The soil of the experimental site was loamy with pH 7.5, available N= 202.80 kg/ha, P=24.52 kg/ha and K=158.10kg/ha at the start of experiment.

Crop Parameters

The height of eight randomly selected flower plants from each plot was recorded in centimeters from ground level to tip of plant. Plant spread and flower size was taken as the average width of the selected plants/flowers from end to end point. Number of flowers in each plant was counted and per plant flower weight was measured. Flower duration was also recorded as the period during which flower bud opened to withering of petals. Seed yield of each plot was recorded and finally yield was extrapolated on a hectare basis.

Tree Parameters

Height of the trees was measured in meters (m) from ground level to the tip of the main shoot of the trees with the help of Indian made multimeter. The diameter at breast height was measured in centimeters (cm) with the help of digital caliper at 1.37 m above the ground level. The crown spread was measured in meters (m) using measuring tape from the tree trunk in east-west and north-south directions and holding two poles straight touching tip of the opposite sides of the tree. Height of

crown was measured in meters (m) from ground level to lowest shoot of the trees with the help of graduated measuring rod. The tree volume (m3) and fresh biomass (kg/tree) was estimated through the regression equations developed in prevailing conditions by Sharma et al. (2007).

Statistical Analysis

Statistical analysis of data was performed as per the procedure explained by Gomez and Gomez (1984) and using CPCS-1 software developed by the Department of Mathematics and Statistics, PAU Ludhiana (India).

Results And Discussion

Winter Flowering Annuals

The data presented in Tables 1-5 revealed non-significant effect in plant height, plant spread, number of flowers per plant, flower size, fresh flower weight, seed yield per plant and seed yield (quintal/ha) during the three years of study. Though, the response of crops during all the three years for growth and seed yield under tree canopy and open condition was significant. Crops differed significantly with higher values in open than under a poplar canopy. The interaction effect of different factors in different parameters was found significant but not discussed due to their complex nature though evident in tables. However, response of crops during the three years followed the same pattern though values decreased with increase in age of poplar plantation. Flowering duration was comparatively longer under the poplar canopy than in the open (Table 6). Flowering was extended in all the crops mainly due to negative interaction of trees on crops for light, moisture and change in microclimate under the trees. The extended shade under poplar canopy had adverse effects on vegetative growth i.e. plant height, plant spread, flower size, etc. and delayed physiological maturity under low light, low temperature and higher humidity under canopy than open condition. Variation in flowering duration among different crops is due to different periods of flowering and its relation to the phenology of poplar trees. Flowers remained open for the longest duration in Gaillardia pulchelia than in other crop, whereas, Verbena hybrida lasted for a minimum number of days. Hadi et al. (2006) and Nasurullahzadeh et al. (2007) reported delayed maturity under low light including increased flowering period and grain filling duration. The seed yield was significantly higher in the open than under poplar canopy (Table 7). Highest seed yield was observed in Coreopsis tinctoria and low in Helichrysum bracteatum and in Petunia hybrida. The variable conditions of crop growing and different crops exhibited significant variation for per plant seed yield. The differences in seed yield irrespective of crops and growing conditions during the three years were marginal and non-significant, which may be due to non-significant differences in tree crown spread during both the years and intrinsic potential of the crops.

Tree Parameters

The data on growth parameters of three, four and fifth year old poplar tree are presented in Table 9. Trees showed significant differences for growth and yield parameters between growing environments. The performance of trees in agroforestry plantations was significantly more than in the pure plantation. Non-significant differences in crown spread were noticed during the years and also within the environments. The non-significant differences in crown spread are due to the pruning exerted in the trees required for knot free clean boles and more light for inter-cultivated crops. Poplar trees in the present study were pruned annually, thus exhibiting less variation in canopy. The leaf area index values recorded during the crop season also exhibited a non-significant variation. Values under agroforestry ranged from 0.063 - 0.311 and in pure plantation 0.048 - 0.303. The tree volume and biomass followed the trend of tree height/diameter and significant differences in both the parameters were recorded over the year of growth and the environment of cultivation. The poplar trees showed better growth in the inter-cultivation than uncultivated conditions. The higher production of poplar when cultivated with seasonal crops may be due to the benefits drawn by the poplar by the various agricultural inputs. Singh and Sharma (2007) also recorded 17.2 and 15.6 per cent increases in tree height and diameter in fodder-wheat intercropping. The higher growth is also due to ideal environmental conditions i.e., humidity, temperature, etc. under inter-cultivated crops.

Economic analysis

Benefit: cost ratio of growing flowers for seed production ranged from 1.72 (Helichrysum bracteatum) to 5.61 (Gaillardia pulchelia) under open conditions but 1.23 (Chrysanthemum multicaul) to 4.49 (Petunia hybrida) under poplar canopy. Similarly Benefit: cost ratio of wheat cultivation recorded in control was comparatively higher (1.64) than under poplar canopy (0.66) (0.66) was comparatively less than the flower seed production (Table 10). All the flower crops were found quite remunerative than the traditionally grown wheat crop in open as well as under poplar canopy. However, on system basis the results are very different and when timber value is included, the benefit cost ratio shifts in favour of agroforestry. Kumar et al. (2004), Singh and Dhaliwal (2005), Chaudhary et al. (2007) and Dwivedi et al. (2007) have also reported that tree-crop interaction have adverse affect on crop productivity but the system productivity as well as profitability increases substantially.

Conclusion

Various yield and yield contributing parameters of flowering annuals depicted their low performance in association with poplar than open condition. But, flower seed production of these species under poplar canopy was found quite remunerative and offer excellent opportunities for farm diversification

with higher income than growing traditional wheat crop. Flower seed demands are increasing in developed countries and farmers can benefit through modified microclimate under tree canopy to raise flower annuals for seed.

Table 1: Plant height (cm) of winter flower annuals under poplar canopy and open condition

Crops	Poplar (3rd year)	Control	Yearly Mean	Poplar (4th year)	Control	Yearly Mean	Poplar (5th year)	Control	Yearly Mean	Poplar	Control	Crop Mean
Verbena hybrida	29.50	29.44	29.47	21.50	18.94	20.22	29.00	32.00	30.50	26.67	26.79	26.73
Gamolepis elegans	27.63	21.69	24.66	20.94	21.00	20.97	30.17	25.3	27.74	26.25	22.66	24.46
Petunia hybrida	64.94	63.19	64.07	65.69	60.25	62.97	65.00	66.00	65.50	65.21	63.15	64.18
Dimorphotheca aurantiaca	19.94	21.88	20.91	21.44	21.63	21.54	20.17	24.00	22.09	20.52	22.50	21.51
Chrysanthemum multicaul	22.19	22.25	22.22	23.47	19.75	21.61	23.00	24.00	23.50	22.89	22	22.44
Phlox drumondii	25.25	48.44	36.85	26.50	29.81	28.16	26.00	47.67	36.84	25.92	41.97	33.95
Gaillardia pulchella 80.38		81.31	80.85	81.00	75.38	78.19	77.11	77.33	77.22	79.50	78.01	78.75
Helichrysum bracteatum	74.19	73.38	73.79	74.56	66.31	70.44	70.00	75.00	72.50	72.92	71.56	72.24
Calendula officinalis	39.88	41.94	40.91	28.00	39.94	33.97	40.4	46.00	43.20	36.09	42.63	39.36
Coreopsis tinctoria	76.31	76.13	76.22	84.38	115.44	99.91	75.33	77.00	76.17	78.67	89.52	84.10
Coreopsis lanceolata	76.50	73.06	74.78	73.69	79.13	76.41	76.84	80.17	78.51	75.68	77.45	76.58
Dianthus barbatus	33.81	46.31	40.06	35.38	58.56	46.97	35.34	45.00	40.17	34.84	49.96	42.4
Mean	47.54	49.92	48.73	46.38	50.51	48.45	47.36	51.62	49.49	47.09	50.68	48.89
CD at 5%	Years : NS Conditions : 0.85 Crops : 1.34					Years x Conditions : NS Years x Crops : 2.86 Conditions x Crops : 2.86 Years x Conditions x Crops : 5.88						

Table 2: Plant spread (cm) of winter flower annuals under poplar canopy and open condition

Crops	Poplar 3rd year)	Control	Yearly mean	Poplar (4th year)	Control	Yearly mean	Poplar (5th year)	Control	Yearly mean	Pooled average		
										Poplar	Control	Pool mean
Verbena hybrid	19.06	21.06	20.06	23.06	23.63	23.34	16.58	20.06	18.32	19.57	21.58	20.58
Gamolepis elegans	23.75	24.75	24.25	27.69	29.63	28.66	25.92	26.01	25.965	25.79	26.79	26.29
Petunia Hybrid	41.69	43.19	42.44	42.44	46.50	44.47	26.67	40.58	33.625	36.93	43.42	40.18
Dimorphotheca aurantiaca	27.38	36.19	31.78	27.38	34.88	31.13	27.50	30.33	28.915	27.42	33.80	30.61
Chrysanthemum multicaul	28.88	36.13	32.50	31.81	35.88	33.84	30.00	37.00	33.5	30.23	36.34	33.28
Phlox drumondii	28.63	30.69	29.66	21.69	26.94	24.31	22.00	29.67	25.835	24.11	29.10	26.61
Gaillardia pulchella	43.19	47.25	45.22	49.69	53.06	51.38	47.01	49.33	48.17	46.63	49.88	48.26
Helichrysum bracteatum	34.38	36.44	35.41	23.69	23.88	23.78	34.34	37.00	35.67	30.8	32.44	31.62
Calendula officinalis	32.81	34.69	33.75	26.75	32.13	29.44	37.30	39.83	38.565	32.29	35.55	33.92
Coreopsis tinctoria	41.38	42.75	42.06	42.56	44.50	43.53	29.50	35.00	32.25	37.81	40.75	39.28
Coreopsis lanceolata	39.25	45.69	42.47	38.75	48.38	43.56	39.84	38.17	39.005	39.28	44.08	41.68
Dianthus barbatus	11.88	15.06	13.47	9.47	12.44	10.95	12.00	16.00	14	11.12	14.5	12.81
Mean	31.02	34.49	32.76	30.41	34.32	32.37	29.06	33.25	31.15	13.16	34.02	23.59
CD at 5%	Years : NS Conditions : 1.31 Crops : 1.92					Years x Conditions : NS Years x Crops : 3.01 Conditions x Crops : 3.01 Years x Conditions x Crops : 2.33						

Table 3: Number of flower/plant of winter annuals under poplar canopy and open condition

Crops	Poplar 3rd year)	Control	Yearly mean	Poplar (4th year)	Control	Yearly mean	Poplar (5th year)	Control	Yearly mean	Pooled average		
										Poplar	Control	Pool mean
Gamolepis elegans	60.50	62.75	61.63	57.75	62.5	60.125	55.84	63.67	59.755	58.03	62.97	60.5
Petunia hybrida	42.00	38.50	40.25	39.25	36.25	37.75	26.67	36.17	31.42	35.97	36.97	36.47
Dimorphotheca aurantiaca	28.25	30.25	29.25	29.00	30.25	29.625	29.84	39.00	34.42	29.03	33.17	31.1

Chrysanthemum multicaul	62.75	64.50	63.63	69.31	70.50	69.905	50.75	58.00	54.38	60.94	64.33	62.64
Phlox drumondii	101.75	206.25	154.00	124.69	271	197.85	48.83	85.00	66.92	91.76	187.42	139.60
Gaillardia pulchella	37.75	36.00	36.88	37.62	41.50	39.56	17.88	39.00	28.44	31.08	38.83	34.96
Helichrysum bracteatum	25.25	23.75	24.50	18.56	16.25	17.41	27.00	28.50	27.75	23.6	22.83	23.22
Calendula officinalis	21.00	21.5	21.25	20.75	21.75	21.25	34.25	44.33	39.29	25.33	29.19	27.26
Coreopsis tinctoria	110.00	134.5	122.25	94.50	111.25	102.88	44.00	99.50	71.75	82.83	115.08	98.96
Coreopsis lanceolata	44.25	51.00	47.63	24.75	51.75	38.25	25.00	50.84	37.92	31.33	51.01	41.17
Dianthus barbatus	51.25	52.00	51.63	45.62	49.25	47.44	45.55	58.67	52.11	47.47	53.31	50.39
Mean	55.75	67.92	61.83	55.71	71.88	63.79	38.95	55.96	47.46	50.14	65.23	57.68
CD at 5%	Years : NS Conditions : 1.41 Crops : 4.46			Years x Conditions : 2.25 Years x Crops : 7.81 Conditions x Crops : 7.81 Years x Conditions x Crops : 16.11								

Table 4: Flower size (cm) of winter flower annual under poplar canopy and open conditions

Crops	**Poplar 3rd year)**	**Control**	**Yearly mean**	**Poplar (4th year)**	**Control**	**Yearly mean**	**Poplar (5th year)**	**Control**	**Yearly mean**	**Pooled average**		
										Poplar	**Control**	**Pool mean**
Verbena hybrida	1.86	1.97	1.92	1.77	1.76	1.77	1.88	1.99	1.94	3.13	3.06	3.10
Gamolepis legans	2.93	2.51	2.72	2.86	2.87	2.87	3.59	3.80	3.69	5.51	5.74	5.63
Petunia hybrida	5.18	5.36	5.27	6.33	6.75	6.54	5.01	5.10	5.06	5.94	5.91	5.93
Dimorphotheca aurantiaca	6.45	6.13	6.29	5.11	5.59	5.35	6.27	6.00	6.14	2.45	2.55	2.5
Chrysanthemum multicaul	2.39	2.18	2.29	2.55	3.03	2.79	2.40	2.45	2.43	2.33	2.47	2.4
Phlox drumondii	2.27	2.47	2.37	2.34	2.52	2.43	2.38	2.43	2.41	5.03	5.26	5.15
Gaillardia pulchella	5.39	5.53	5.46	4.49	4.98	4.74	5.21	5.28	5.25	4.4	4.37	4.39
Helichrysum bracteatum	4.48	4.36	4.42	4.45	4.25	4.35	4.26	4.50	4.38	5.47	4.91	5.19
Calendula officinalis	5.34	4.64	4.99	5.50	5.00	5.25	5.57	5.10	5.34	5.38	4.9	5.14
Coreopsis tinctoria	5.78	5.69	5.735	4.99	3.57	4.28	5.38	5.45	5.42	5.97	5.8	5.89

Coreopsis lanceolata	5.98	5.69	5.835	5.73	5.51	5.62	6.21	6.19	6.20	1.94	1.84	1.89
Dianthus barbatus	1.86	1.62	1.74	2.00	1.90	1.95	1.95	2.00	1.98	4.12	4.06	4.09
Mean	4.16	4.01	4.09	4.01	3.98	3.99	4.18	4.19	4.18	4.31	4.24	4.27
CD at 5%	Years : NS Conditions : NS Crops : 0.33				Years x Conditions : NS Years x Crops : NS Conditions x Crops : NS Years x Conditions x Crops : 0.39							

Table 5: Effect of poplar on fresh flower weight/plant (gm) of inter-cultivated winter flower annuals

Crops	**Poplar 3rd year)**	**Control**	**Yearly mean**	**Poplar (4th year)**	**Control**	**Yearly mean**	**Poplar (5th year)**	**Control**	**Yearly mean**	**Pooled average**		
										Poplar	**Control**	**Pool mean**
Verbena hybrida	2.51	2.46	2.49	2.86	2.98	2.92	1.84	1.80	1.82	2.74	2.41	2.58
Gamolepis elegans	7.98	8.51	8.25	7.82	8.49	8.16	7.37	8.63	8.00	7.87	8.54	8.21
Petunia hybrida	12.23	10.76	11.50	9.62	11.71	10.67	7.77	10.11	8.94	10.49	10.86	10.68
Dimorphotheca aurantiaca	8.51	9.77	9.14	9.77	9.29	9.53	8.99	12.59	10.79	9.35	10.55	9.95
Chrysanthemum multicaul	33.41	33.37	33.39	35.84	36.69	36.27	27.02	30.01	28.52	35.03	33.36	34.19
Phlox drumondii	4.14	8.39	6.27	4.49	11.03	7.76	1.99	3.46	2.73	4.37	7.63	6.00
Gaillardia pulchella	61.59	62.90	62.25	65.75	73.96	69.86	29.17	68.14	48.66	64.36	68.33	66.35
Helichrysum bracteatum	58.75	36.89	47.82	35.70	38.78	37.24	62.82	44.27	53.55	43.38	39.98	41.68
Calendula officinalis	28.01	28.51	28.26	27.18	29.58	28.38	45.68	58.78	52.23	27.46	38.96	33.21
Coreopsis tinctoria	76.07	99.22	87.65	70.01	82.43	76.22	30.43	73.40	51.92	72.03	85.02	78.53
Coreopsis lanceolata	33.56	38.68	36.12	18.76	39.25	29.01	18.96	38.56	28.76	23.69	38.83	31.26
Dianthus barbatus	9.68	10.02	9.85	4.82	17.27	11.05	8.49	11.31	9.9	6.44	12.87	9.66
Mean	28.04	29.12	28.58	24.39	30.12	27.25	20.88	30.09	25.48	25.6	29.78	27.69
CD at 5%	Years : NS Conditions : 2.44 Crops : 3.98				Years x Conditions : 3.11 Years x Crops : 6.49 Conditions x Crops : 6.49 Years x Conditions x Crops : 9.32							

Table 6: Flowering duration* of inter-cultivated winter flower annuals under poplar canopy and open condition

Crops	Control	3rd year poplar canopy	Control	4th year poplar canopy	Control	5th year poplar canopy
Verbena hybrida	25th February-7th April (42)	4th March-20th April (48)	4th March - 15th May (73)	8th March-25th May (79)	20th February-1th April (41)	3th March-20th April (49)
Gamolepis elegans	10th January15th March (65)	15th January-1st April (77)	26th January - 27th March (61)	2nd February-12th April (70)	5th January-10th March (65)	15th January-1st April (77)
Petunia hybrida	5th March- 24th May (77)	3rd March-30th May (84)	3rd March - 26th May (83)	10th March-30th May (85)	4th March- 20th May (78)	3rd March-30th May (89)
Dimorphotheca aurantiaca	1st March- 20th April (51)	7 March-30th April (55)	6th March - 25th April (51)	9th March-30th April (61)	3rd March- 20th April (48)	9 March-30th April (53)
Chrysanthemum multicaul	10thFebruary-2th April (52)	28th February-20th April (66)	11th February- 6th April (55)	15th February-15th April (60)	8th February-20th March (41)	15th February1st April (46)
Phlox drumondii	25thFebruary28th April (63)	10th March-15th May (67)	10th March - 28th May (80)	11th March-29th May (80)	25th February28th April (63)	10th March-15th May (67)
Gaillardia pulchella	5th May - 15th July (74)	8th May-27th July(81)	1st May- 3rd August (95)	10th May-22nd August (105)	1st May - 10th July (71)	8th May-25th July(79)
Helichrysum bracteatum	1th March- 15th May (76)	6th March-25th May (81)	5th March - 16th May (73)	10th March-29th May (81)	2th March- 15th May (75)	6th March-25th May (81)
Calendula officinalis	15thFebruary-6th April (51)	18th February-15th April (57)	15th February to 1st April (46)	20th February-21st April (61)	20th February10th April (49)	25th Februar y 20th April (55)
Coreopsis tinctoria	10th April- 25th June (77)	13th April-10th July (89)	14th April to 30th June (78)	16th April-15th July (91)	15th April- 25th June (72)	20th April-1th July (73)
Coreopsis lanceolata	11th April- 25th June (86)	14th April-16th July (94)	14th April to 13th June (91)	20th April-22nd July (94)	11th April- 25th June (86)	14th April-16th July (94)
Dianthus barbatus	25th January28th March (63)	30th January-18th April (79)	23rd January-25th March (63)	28th January-20th April (83)	25th February31th March (35)	1st march-15st April (46)

* Number of days in parentheses

Table 7: Effect of poplar on seed yield per plant (gm) of inter-cultivated winter flower annuals

Crops	Poplar (3rd year)	Control	Yearly mean	Poplar (4th year)	Control	Yearly mean	Poplar (5th year)	Control	Yearly mean	Pooled average		
										Poplar	Control	Pool mean
Verbena hybrid	2.40	2.18	2.29	1.86	2.13	1.99	1.76	1.46	1.61	2.01	1.92	1.97
Gamolepis elegans	2.14	2.48	2.31	2.10	2.40	2.25	1.98	2.52	2.25	2.07	2.47	2.27
Petunia Hybrid	1.25	1.36	1.30	1.21	1.29	1.25	0.79	1.28	1.04	1.08	1.31	1.19
Dimorphotheca aurantiaca	1.35	1.58	1.47	1.28	1.53	1.40	1.42	2.04	1.73	1.35	1.72	1.54

Chrysanthemum multicaul	1.18	1.57	1.37	1.16	1.54	1.35	0.95	1.41	1.18	1.10	1.51	1.31
Phlox drumondii	1.44	1.61	1.53	1.42	1.72	1.57	0.69	0.66	0.68	1.18	1.33	1.26
Gaillardia pulchella	4.11	4.51	4.31	4.10	4.54	4.32	1.94	4.88	3.41	3.38	4.64	4.01
Helichrysum bracteatum	1.13	1.37	1.25	1.11	1.31	1.21	1.48	1.65	1.57	1.24	1.44	1.34
Calendula officinalis	1.88	2.04	1.96	1.85	2.00	1.93	2.33	2.42	2.38	2.02	2.15	2.09
Coreopsis tinctoria	5.42	5.75	5.59	5.39	5.69	5.54	2.17	4.25	3.21	4.33	5.23	4.78
Coreopsis lanceolata	4.36	4.60	4.48	4.32	4.54	4.43	2.46	4.59	3.53	3.71	4.58	4.15
Dianthus barbatus	1.69	1.99	1.84	1.67	1.95	1.81	1.50	2.24	1.87	1.62	2.06	1.84
Mean	2.36	2.59	2.47	2.29	2.55	2.42	1.62	2.45	2.04	2.09	2.53	2.31
CD at 5%	Years : NS				Years x Conditions : NS							
	Conditions : 0.11				Years x Crops : NS							
	Crops : 0.61				Conditions x Crops : NS							
					Years x Conditions x Crops : NS							

Table 8: Seed yield (q/acre) of winter flower annuals under poplar canopy and open condition

Crop♦	**Poplar (3rd year)**	**Control**	**Yearly mean**	**Poplar (4th year)**	**Control**	**Yearly mean**	**Poplar (5th year)**	**Control**	**Yearly mean**	**Pooled average**		
										Poplar	**Control**	**Crop mean**
Verbena hybrida	1.07	0.97	1.02	0.82	0.94	0.88	0.78	0.65	0.72	0.89	0.85	0.87
Gamolepis elegans	0.95	1.10	1.03	0.93	1.07	1.00	0.88	1.12	1.00	0.92	1.09	1.01
Petunia hybrida	0.55	0.60	0.58	0.54	0.57	0.56	0.35	0.57	0.46	0.48	0.58	0.53
Dimorphotheca aurantiaca	0.60	0.70	0.65	0.57	0.68	0.62	0.63	0.91	0.77	0.6	0.76	0.68
Chrysanthemum multicaul	0.52	0.70	0.61	0.51	0.68	0.60	0.42	0.63	0.53	0.48	0.67	0.57
Phlox drumondii	0.64	0.72	0.68	0.63	0.77	0.70	0.31	0.29	0.30	0.52	0.59	0.55
Gaillardia pulchella	1.82	2.01	1.91	1.82	2.02	1.92	0.86	2.17	1.52	1.50	2.07	1.78
Helichrysum bracteatum	0.50	0.61	0.56	0.49	0.58	0.54	0.66	0.73	0.69	0.55	0.64	0.59
Calendula officinalis	0.84	0.91	0.87	0.82	0.89	0.86	1.04	1.08	1.06	0.90	0.96	0.93
Coreopsis tinctoria	2.41	2.55	2.48	2.39	2.53	2.46	0.96	1.89	1.43	1.92	2.32	2.12
Coreopsis lanceolata	1.93	2.04	1.99	1.92	2.02	1.97	1.09	2.04	1.57	1.65	2.03	1.84

Dianthus barbatus	0.75	0.88	0.82	0.74	0.87	0.80	0.67	0.99	0.83	0.72	0.91	0.815
Mean	1.05	1.15	1.10	1.02	1.13	1.08	0.72	1.09	0.91	0.93	1.12	1.025
Triticum aestivum	79.0	91.3	85.1	69.99	80.6	75.3	70.0	80.0	65.0	73.0	83.97	78.4
CD at 5%	Years : 0.12					Years x Conditions : NS						
	Conditions : 0.22					Years x Crops : NS						
	Crops : 0.39					Conditions x Crops : NS						
						Years x Conditions x Crops : NS						

Table 9 : Growth performance of Populus deltoides under farm forestry

Parameters / **Conditions**	3rd year			4th year			5th year			CD at 5%
	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	
Tree height (m)	8.38	7.40	7.89	15.67	13.53	14.60	21.96	19.66	20.81	Year :1.21 Condition :1.43 Year x condition: NS
DBH (cm)	8.57	7.19	7.88	16.06	14.70	15.38	14.15	12.55	13.35	Year :1.18 Condition:1.03 Year x condition: NS
Crown spread (m)	3.23	3.20	3.21	4.07	3.79	3.93	4.69	4.33	4.51	Year :NS Condition :NS Year x condition: NS
Crown height (m)	4.15	3.85	4.00	9.09	7.72	8.40	16.38	14.85	15.62	Year :1.28 Condition :NS Year x condition: NS
Volume (cum)	0.06	0.038	0.049	0.40	0.292	0.35	0.805	0.676	0.739	Year :0.081 Condition :NS Year x condition: NS
Timber dry weight (kg/ tree)	10.06	6.44	8.13	53.13	41.10	46.88	90.07	80.34	82.09	Year :5.25 Condition :3.87 Year x condition: NS
Total tree dry biomass (kg)	53.39	44.79	49.09	178.35	163.27	170.82	117.26	105.58	111.35	Year :19.48 Condition :5.29 Year x condition: NS

E1-Agroforestry plantation

E2-Pure plantation

Table 10: Comparative economics of flowers meant for seed production and traditionally grown wheat crop*.

items	Yield (q/acre)	Gross returns (Rs)	Total variable cost (Rs)	Return over variable cost	Benefit : cost ratio
Verbena hybrida	0.89 (0.85)	26,700 (25,500)	6,465 (6,705)	20,235 (18,795)	3.13 (2.80)
Gamolepis elegans	0.92 (1.09)	23,000 (27,250)	6,108 (6,200)	16,892 (21,050)	2.77 (3.39)
Petunia hybrida	0.48 (0.58)	38,400 (46,400)	7,000 (7,281)	31,400 (39,119)	4.49 (5.37)
Dimorphotheca aurantiaca	0.6 (0.76)	18,000 (22,800)	6,465 (6,705)	11,535 (16,095)	1.78 (2.40)
Chrysanthemum multicaul	0.48 (0.67)	14,400 (20,100)	6,465 (6705)	7,935 (13,395)	1.23 (1.99)
Phlox drumondii	0.52 (0.59)	18,200 (20,650)	6,568 (6,705)	11,632 (13,945)	1.77 (2.08)
Gaillardia pulchelia	1.50 (2.07)	37,500 (51,750)	7,615 (7,927)	29,885 (44,505)	3.92 (5.61)
Helichrysum bracteatum	0.55 (0.64)	16,500 (19,200)	6,965 (7,245)	9,535 (12,495)	1.37 (1.72)
Calendula officinalis	0.90 (0.96)	18,000 (19,200)	6,465 (6,705)	11,535 (12,495)	1.78 (1.86)
Coreopsis tinctoria	1.92 (2.32)	30,720 (37,120)	7,615 (7,823)	23,105 (29,297)	3.03 (3.74)
Coreopsis lanceolata	1.65 (2.03)	26,400 (32,480)	7,615 (7,823)	18,785 (24,657)	2.47 (3.15)
Dianthus barbatus	0.72 (0.91)	21,600 (27,300)	6,465 (6,602)	15,135 (20,698)	2.34 (3.13)
Treticum astivum A, main product B, by product	10.87 (17.17) 16.0 (26.0)	13,394 (21,231)	8,555 (8,555)	5,339 (13,176)	0.66 (1.64)

***Control conditions in parentheses**

1. Crop enterprise budgets are subject to prevailing weather conditions of 2008-09.
2. All input/technologies are used as per the PAU recommendations.

3. Inputs are valued at the prevailing market prices. Seedling cost is not included in input cost.

4. Fixed costs such as land rent, depreciation, etc are not included.

5. Benefit has been calculated on the prevailing flowering annuals seed rates.

The benefit: cost ratio for a particular crop and inter-crop comparisons should therefore be viewed cautiously

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Farming fodder species on terrace riser: Identification of new sustainable crop and livestock production model of agroforestry system

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Abstract

Two dozens of fodder species were evaluated in terrace riser of bari land under agri-silvo-pastoral system in the hills (1200-2000 masl) of eastern Nepal during the last decade. The results showed that improved forage crops and fodder trees can be cultivated successfully in the terrace risers of cropping land where performance of fodder species found encouraging. Survival of the fodders found 70 to 100 percent based on species. Dry matter content of trees varied 31-49 percent, and ground forages, 19-32 percent. Dry matter yield ranged 3.0 t/ha (Stylo) to 26.5 t/ha (Napier). Similarly growth and yield of maize and finger millet found less affected by the trees in new agroforestry design tested for the first time in Nepal. Lopping fodder trees at breast height in second-third year not allowing grow taller prevented from shade effect to the crop. Trees were planted narrow (1-1.5m) on the terrace edge and coppices were harvested as fodder. Ground forages were planted at 30-50cm under the fodder trees. There was little positive effect of Tanki (Bauhinia purpurea), Bhimal/Ghotli (Grewia oppositifolia), Patmero (Litsea polyantha), Khari (Seltis australis) whereas Raikhanyu (Ficus semicordata) and Nebaro (Ficus auriculata) had some negative effect on maize but had higher fodder yield. The forages Napier, Dhus, Amriso, Desmodium, Ryegrass, Para, Molasses, Stylo performed best. This paper includes the quantified data of forages, maize and millet. The farmers and district stakeholders highly impressed while visiting the experimental plots. They liked the new model and requested fodder saplings to plant. This practice was noted as a successful technology and recommended to replicate in the similar eco regions by the district agencies/ service providers.

Key words: *Terrace riser, Fodder species, Maize, Millet, Agri-silvo-pastoral model*

Introduction

"Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, bamboos etc.) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence." Declaration of 1st World Congress of Agroforestry (Barakoti, 2004) mentions "Agroforestry is now a science without borders, can tackle problems of biodiversity, rural poverty, deforestation, land

degradation, genetic erosion, soil fertility decline, climate change, environment, food and nutritional security".

Fodder trees form an integral part of the hill agriculture system under traditional agroforestry practices in Nepal. They provide fodder and bedding for animals, wood for cooking, heating, and for other household purposes to meet the daily need of the rural communities. The traditional farming system, agroforestry, fulfills the growing demand of fodder, fuel-wood and farm yard manure and ultimately contributes to the welfare of people. It helps sustain the hill farming system, prevent land degradation, improve environment and reduce women's drudgery. However over exploitation of forests has led to farmers becoming increasingly dependent on trees from private land. Carter and Gilmour (1989) reported that farmers responded to the declining forest situation by growing more trees on farmland, however adverse effect of trees on crops is a constraint (Joshi and Thapa, 1993). Extensive use of tree fodders is a common practice and there is high scope of agroforestry for the hill farming communities (Barakoti, 2004, Amatya, 1999; Karki, 1992).

Available literatures suggest that effect of trees on crop growth and yield varies with tree species, size, distance from tree and crop species. Shading, water dripping, root disturbance, competition for nutrient and moisture are the negative impact of tree-crop interface, which have been experienced by the local people (Joshi, 1997, Thapa, 1994, Carter, 1991). It is believed that leguminous trees such as Leucaena spp., Albizia spp., Acacia spp., Bauhinia spp. have a positive influence on adjacent crop. Farmers in the eastern hills classify trees grown in cropping land into Rukho (unfertile) for negatively affecting species and Malilo (fertile) for positively affecting species on the succeeding crops. They also categorize nutritious fodder as Posilo for the livestock (Joshi and Thapa, 1993).

In Dhankuta district, farmers found interested to plant fodder trees in their bari land. They selected 28 species however fodder producing, nitrogen fixing, and soil conserving species are given priority (Baral and Amatya, 2000). Barakoti et al (1999) found positive effect on wheat and negative effect on maize in alley cropping of mixed tree species (Artocarpus lakoocha, Bauhinia purpurea, Eucalyptus camaldulensis, Leucaena leucocephala, Madhuca latifolia) in Tarai (Rampur), where intercropping was encouraging in the on-farm condition (Barakoti, 1990). Puri and Bangarwa (1992) reported that in Haryana (India), trees limited wheat yield up to a distance of 3m from the tree, while beyond 7m there was no impact. Likewise, Acacia nilotica affected wheat yield and prolonged maturity, while Dalbergia sissoo had less effect. In Pakistan Albizia procera, Eucalyptus camaldulensis, Leucaena leucocephala, Morus alba had no effect on wheat yield beyond 2m (Akbar et al, 1990).

Most researches on tree-crop interface are concentrated on flat land, while little information is available for the hills. Neupane (2004) concluded that farmers in the hills normally do not consider environmental benefits, such as soil conservation, landslide prevention, fertility improvement, nutrient recycling and pumping nutrients from deeper soil layer. They look tangible benefits. Hence, introducing holistic model of agroforestry possesses multifaceted value.

Need of Terrace Riser based Agroforestry Model

- Crop and animal production are interdependent, particularly in hills, need to sustain both.
- Farmers have to meet daily need of fodder for livestock, leaf litter for manure and fuel-wood for cooking.

- Lack of fodder is crucial, need to increase fodder supply during lean period of the year.
- Majority of farmers has small holdings, limited land for fodder planting/production.
- 1/3 land in terrace riser in the hills is left unutilized, uncultivated.
- Need to apply increased organic manure for soil fertility and crops productivity.
- Fodder collection time is saved and reduces the women's drudgery.
- To help control erosion, conserve soil and improve farm environment.

Objectives

The main objective of the research was to explore feasibility of forage crops production in terrace riser (T-riser) by testing new model hypothesis of agri-silvo-pastoral system. However the specific objectives were:

- To evaluate survival and growth performance of fodder trees and improved forage species in the T-riser.
- To quantify combined effect of fodder trees and forages crops on maize and finger millet.

Materials And Methods

Field Experiments and verification trials were conducted in various locations/ VDCs of Dhankuta, Terhathum and Ilam districts during the years 2003-2008. However, the results of few experiments of Dhankuta only are presented here. The number of trees and forages in different experiments were as following:

Study Site:

Patle village, Dhankuta district, mid hill 1200-1400 masl.

Expt.1: 6 fodder trees & 7 forage spp,

Expt.2: 5 fodder trees & 4 forage spp

On-station observation plot, ARSP, 1900 masl

Expt.3: 10 fodder trees & 12 forage spp

Expt.4: 16 fodder trees & 16 ground forage spp.

Design:

RCBD & Split plot

Replication: 2-4. Plot size: 2-2.5m high X 3-6m long

Spacing: 1 row trees at 1-1.5m, Ground forage: 30-50x50cm

Verification Trials: planted at 14 farmers' land.

Fodder Tree Species:

The experimented 16 fodder trees were both leguminous and non-leguminous and indigenous, except ipil-ipil, preferred by the farmers in hills and Tarai from east to west of the country. Most of them were multipurpose. Those species were namely as following:

1.	Badahar	*Artocarpus lakoocha*
2.	Banjh	*Quercus glauca*
3.	Bhimal	*Grewia oppositifolia*
4.	Dudhilo	*Ficus nemarolis*
5.	Gogun	*Saurauria nepaulensis*
6.	Ipil-ipil	*Leucaena diversifolia*
7.	Kabro	*Ficus lacor*
8.	Khari	*Seltis australis*
9.	Kimbu	*Morus alba*
10.	Koiralo	*Bauhinia variegata*
11.	Kutmiro	*Litsea polyantha*
12.	Nebaro	*Ficus auriculata*
13.	Painyu	*Prunus cerasoides*
14.	Raikhanyu	*Ficus semicordata*
15.	Rato Siris	*Albizia jullibrissin*
16.	Tanki	*Bauhinia purpurea*

Ground Forage Species:

The selected 16 forages for the experiments were mostly improved species and exotic. Amriso was the endemic, Dhus, Napier, desmodium were already localized. Other species were evaluated by PFRD NARC, Khumaltar and other organizations, found promising and recommended. The species were:

1.	Amriso	*Thysalonaema maxima*
2.	Bhatmase	*Flemingia conjesta*
3.	Cock's foot	*Dactylis glomerata*
4.	Desmodium	*Desmodium intortum*

5. Dhus *Pennisetum spp.*
6. Molasses *Melinis minutiflora*
7. Napier *Pennisetum purpureum*
8. Para *Brachiarea mutica*
9. Paspalum *Paspalum dilatatum*
10. Rhodes
11. Ryegrass *Lolium perenne*
12. Setaria *Setaria anceps*
13. Stylo *Stylosanthus guianensis*
14. Kharuki(Local) *Pogonatherum incans*
15. Phurke (Local) *Murdannia elata ?*
16. Salimbo(Local)

Result

Survival

Six fodder trees and six forage crops were experimented in a permanent trial plot in Patle, Dhankuta. Survival of trees was over 90%, except Patmiro which was due to locally collected seedlings (Table 1). Likewise forage species survived over 85 to 100%. The result showed that tree and forage species can be planted and survived in the terrace riser of cropping land.

Table 1: Survival of Fodder trees & Ground forages

Fodder tree species	Survival, %	Ground forage spp	Survival, %
Tanki	100	Amriso	90
Khanyu	95	Napier	100
Nebaro	90	Dhus	85
Patmiro	75	Stylo	85
Bhimal	95	Setaria	100
Dudhilo	90	Desmodium	95

Fodder production

Dry matter (DM) content was analyzed and fodder yield was calculated based on dry matter percent in the fodder. Napier and Setaria had comparatively less dry matter followed by Dhus. However the total production per year per hectare was sharply varied based on the species (Table 2). Napier

found the highest yielder (26.5 t/ha) followed by Dhus and Amriso. Napier was harvested 2-3 times during June to November. Stylo, setaria and desmodium formed less biomass, and the yield ranged 4.7-6.8 t/ha only but are regarded as more nutritious forages.

Table 2: Fodder Production: Dry matter and Yield of ground fodders spp.

Ground fodder	DM range	DM Mean, %	DM yield, t/ha
Amriso	23-36	31.6	12.39
Napier	13-25	19.0	26.54
Dhus	18-38	20.2	20.00
Stylo	24-35	27.4	4.73
Setaria	12-28	19.3	5.76
Desmodium	22-32	24.8	6.80

The dry matter of tree fodders ranged slightly higher than the ground forages (from 20-25 to 34-45%) as shown in Table 3. Mean dry matter (DM) and yield of Raikhanyu was the highest of all (Table 3). Tanki and Dudhilo had low DM yield (133-150 kg/ha) as the trees were small. The high variation between these species was due to vigorous growth of Raikhanyu with tallest plant and long branches.

Table 3: Fodder Production: Dry matter and yields of tree fodders spp.

Fodder tree species	DM range	DM Mean, %	DM yield, kg/ha
Tanki	20-40	28	133
Khanyu	25-44	34	2146
Nebaro	24-36	30	599
Patmiro	25-35	28	756
Bhimal	22-45	32	942
Dudhilo	20-34	27	150

Grain yield of maize

The average yields of maize under different treatments are presented in Table 4. The highest yield was recorded under Nebaro trees that might be due to small not branched tree in the plot followed by Tanki. In most cases, maize in bottom part was more affected by the fodders than edge part particularly by Raikhanyu. This trend was followed by ground fodder Amriso and Dhus. On the average Dudhilo and Raikhanyu had got more negative effect on maize than other fodder tree. Of the forage crops positive effect was found from creeping stylo and desmodium followed by setaria (Table 4).

Table 4: Effect of fodder species on grain yield of maize

Tree fodder	Yield (t/ha) Bottom/Edge= Total	Ground fodder	Yield (t/ha) Bottom/Edge=Total
Nebaro	4.15 / 3.81=7.96	Amriso	2.36 / 3.13=5.49
Dudhilo	2.32 / 2.80=5.12	Dhus	2.34 / 3.09=5.43
Raikhanyu	2.15 / 3.24=5.39	Napier	3.02 / 2.66=5.68
Bhimal	3.09 / 3.55=6.64	Setaria	3.48 / 3.31=6.79
Tanki	3.52 / 3.74=7.26	Stylo	3.43 / 3.64=7.07
Kutmiro	2.73 / 2.76=5.49	Desmodium	3.46 / 3.82=7.28
Control	3.05	Control	3.05

Plant population ranged 36 thousand (Raikhanyu)-48 thousand/ha, the highest number being under Bhimal and Tanki. Dudhilo and Patmiro had also less population than control. The highest fresh yield of stover was obtained under Nebaro followed by Tanki and Bhimal (5.9 t/ha). There was low variation between other trees (3.5-4.7 t/ha). The data were close to control in plant population as affected by forage crops. However it was interesting to note that stover yields (4.4-6.2 t/ha) under all fodder trees were higher than control (3.6 t/ha) as seen in Table 5.

Table 5: Effect of fodder species on plant population and stover yield of maize

Tree fodder	Plant population (000')	Stover yield (t/ha)	Ground fodder	Plant population (000')	Stover yield (t/ha)
Nebaro	43.5	6.89	Amriso	40.6	5.21
Dudhilo	39.1	3.55	Dhus	40.4	4.38
Khanyu	36.1	4.45	Napier	38.8	4.61
Bhimal	48.1	5.93	Setaria	44.1	5.26
Tanki	46.8	6.00	Stylo	42.8	6.22
Patmiro	39.1	4.76	Desmodium	44.8	5.75
Control	43.1	3.55	Control	43.1	3.55

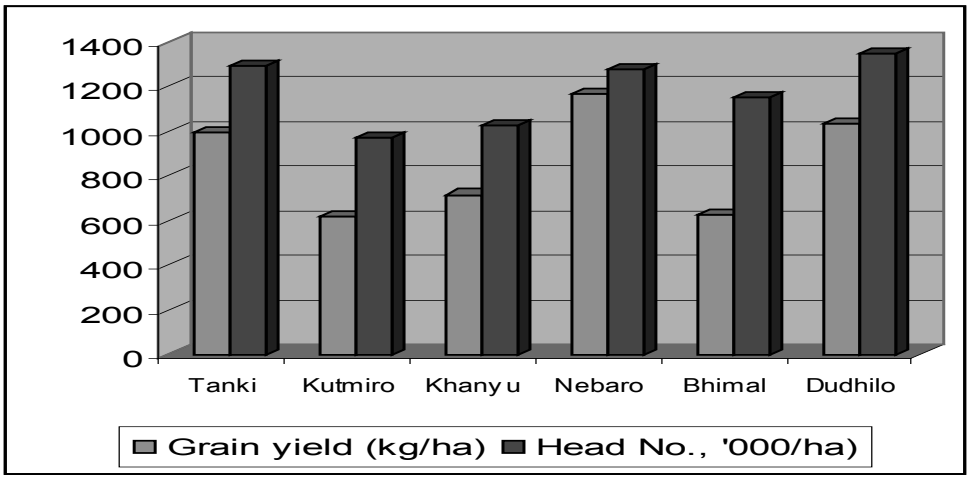
The combined effect of fodder trees (Badahar/Khari/Bhimal/Siris/Kabro) with individual forage crop on height and yield of maize was evaluated at another site of Dhankuta. Grain yield was higher with setaria and desmodium than amriso and napier. Plant height was the highest (212 cm) of all with setaria combination in which stover yield was also highest (7.8 t/ha). Similar quantity was found in other treatments.

Table 6: Grain and Stover Yield, and Plant Height in site 2

Treatment	**Grain yield, t/ha**	**Plant height, cm**	**Stover yield, t/ha**
Amriso/Badahar/Khari/Bhimal /Siris/Kabro	3.58	191	6.75
Napier/Badahar/Khari/Bhimal /Siris/Kabro	3.85	190	6.85
Setaria/Badahar/Khari/Bhimal /Siris/Kabro	4.26	212	7.79
Desmodium/Badahar/Khari/Bhimal /Siris/Kabro	4.12	189	6.50
LSD	1.30	13.4	NS
CV (%)	12	9.7	-

The effect of fodder trees on grain yield of millet was quantified in the same plots where maize was evaluated as maize/ millet relay crop. The result presented in Figure 1 showed that Nebaro favored to form the highest yield of finger millet (1140 kg/ha) followed by Dudhilo and Tanki (980 kg/ha). The head number was the highest (1330 ths/ha) followed by Tanki and Nebaro. Kutmiro and Bhimal had the least numbers (600 ths/ha).

Fig.1: Effect of different fodder trees on grain yield and head No. of finger millet



Farmers' Reaction/ Comments-General

All farmers responded positively to the model and fodders:

- The new model of *Terrace Riser Farming of Fodders* is multi-facet beneficial technology for the farmers.
- Farmers requested to provide fodder saplings for cultivation in larger areas and disseminate the riser farming technique in other districts.

Reasons for preferring fodder trees

- Palatable, livestock like more,
- Could be harvested 2-3 times a year, more fodder production
- Nutritious, help milk production
- Supply green fodder during lean period (Nov-May)
- Support fuel-wood from twigs
- Less effect on maize and other crops, except Raikhanyu.

Reasons for preferring ground forages

The selected/ preferred forage species by the farmers were Setaria, Dhus, Napier, Amriso, Desmodium, and Molasses. The reasons of preference were:

- Fast growing
- High yielding
- Livestock likes
- Milk increasing
- Year round growing
- Supply fodder during dry period
- No problem of mice
- Cash from broom

Problems and Suggestions by Farmers

The participating farmers together with neighbors pointed out some problems and suggestions about the new agroforestry model and the fodder species. The majors were as:

- Difficult to plant, manuring and irrigating in the terrace riser
- Few species have shade effect to maize and other crops
- Amriso and Napier may cause negatively to maize
- Rats may dig out burrows in the riser.
- To plant tree fodders below 2-3' from top of riser or on middle part
- To plant ground fodders below 1-2' from tree fodder
- To plant broom grass on high risers & Napier on small risers.

Conclusion

1. In hills (1200-2000m) improved fodder species can be grown in terrace riser successfully. Survival, growth & yields of Napier, Dhus, Amriso, Setaria, Desmodium, Molasses, Para, Stylo, Ryegrass, is encouraging. Similarly, Ipil-ipil, Raikhanyu, Bhimal, Khari, Kutmiro, Rato Siris grow well and give rise more coppices.
2. Closely planted (1-1.5m) fodder trees felled at breast height for coppicing and their coppices have minimized effect on crops: maize and millet.
3. Combination of tree and ground fodder species is good and excellent in the T-riser as most of them found compatible to plant together.

4. Bhimal, Tanki, Rato Siris, Ipil-ipil have positive effect on maize compared to control, whereas Raikhanyu, Dudhilo and Patmiro have little negative effect.

5. Most ground fodders grow vigorously and give high yield in total of 2-4 cuttings and could be fed to livestock round the year. Napier, Amriso, Dhus have little negative effect.

6. The new riser farming technology model of fodders should be scaled-up throughout hill districts across the country as it may result green and white revolution together.

7. Agroforestry system in general, and this innovative model, in particular, should get priority from the Government and I/NGOs, and need to promote by concerned organizations.

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Agroforestry: In the Lens of Gender Prospective

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Abstract

Promoting off farm resources for economic benefit especially NTFP and herbs cultivation for instances – Timur cultivation in agroforestry system is common. It is realized that a market based solution of Timur to enhance capacities of Timur growers in production, primary processing, value addition and marketing so that the marketable volume of the Timur could be increased along with its value chain. For instance, in land preparations involvement of women is 68 percent in vegetable and 53 percent for Timur. In Timur plantation both women and men have equal role near about 70-75 percent where as in vegetable purely dominated by women, whose work force is accounted for 92 percent. In terms of post harvest of Timur and vegetable mainly 95 percent of women are responsible. In case of product transportation to local market 75 and 91 percent of women are involve in Timur and vegetable respectively. However, in marketing of Timur, men dominancy around 95 percent is commonly observed compared with women involvement (87 percent) in vegetable marketing.

Key words: *Women, Agroforestry, NTFP, Timur, Value chain, Processing, Vegetables, Production, Trade.*

Background

In social scenario, women's contributions are acknowledged for their significant role in the management of agriculture and forest to make the sector more productive and sustainable. Even then we are not far away from our preconceived thinking which coincide with the four myths as mentioned by Fortmann and Rocheleau (1984) that women as housewives, forest products as the domain of men, men as heads of households, and women as passive community members and men dominated society proliferating this concepts knowingly or unknowingly even their internal soul is not agree with this myths.

Economic benefits that derived from agroforestry for the welfare of women are perceived as a driving force to take them out from these myths. In various schools of thought, uses of agro forestry system differ spatially and temporally based in the nature of geography. However, it is an approach to revive local micro environment and economic favorable because of its holistic approach to land use system on the account of people who use this system for their benefits. This type of work initiation have been successfully implementing in intensifying land use and increasing the carrying capacity of the land for economic benefit by including the Non Timber Forest Products (NTFP) Agroforestry model to increase the annual income. This NTFP agroforestry system is practicing

in the project area (study area - Dharapani VDC of Surkhet district in the Surkhet-Jajarkot road corridor of the High Value Agriculture Project in Hill and Mountain Areas (HVAP) where most of the women are engaged in the production of Timur (*Zanthoxylum armatum*) fruits.

Brief Information of HVAP

High Value Agriculture Project in Hill and Mountain Areas (HVAP) is being implemented by Ministry of Agricultural Development (MoAD) and is financed by International Fund for Agricultural Development (IFAD).

The project aims at integrating the rural poor, especially women and marginal groups to the high value agriculture and Non Timber Forest Products (NTFP)/Medicinal and Aromatic Plants (MAP) value chains for improved income, employment opportunities and ability to respond to market demand and opportunities based on marketing agreements with private agribusinesses.

The project approach focuses on a key intervention – the development of pro-poor value chains facilitating mutually beneficial and profitable production and marketing arrangements between producers of high value commodities and agri-business (HVAP, 2012).

Timur (*Zanthoxylum armatum* DC), an aroma bearing fruits is one of the seven products selected for Value Chain by High Value Agriculture Project in Hill and Mountain Areas (HVAP). The promotion of Timur value chain is mainly focused in two road corridors (Surkhet –Dailekha and Surkhet – Jajarkot including the some part of Salyan) of Timur growing area, as it is believed that this has potential to enhance the household income thereby contributing on the poverty reduction of the involved actors particularly in Timur value chain.

Project beneficiaries of the HVAP especially women (101 HHs of the Dharapani VDC, Surkhet district) are mostly involved in Timur cultivation and production, which is regard as a tree species of Agroforesty for additional income.

How do Women see the agroforestry in project area ?

In case of Nepalese women, agroforestry is not a new phenomenon but it is a state of art. By and large women depend on the forest to fulfill their domestic needs such as green manure and mulch for agriculture, fuel wood for household purpose as energy for cooking and heating purpose, fodder for livestock rearing and Timber for various construction purposes. Promoting Private Forests (Trees outside forest) for the production of fast growing tree species and fodder tree to fulfill the household demand of timer, firewood, and fodder and bedding materials. They loved to have tree outside the forest not only for the above mentioned attribution but merely in reducing the drudgery. Women's enslavement on the forest product is directly proportionate to their household time management. For them benefit derived from the tree is site specific because tree access to their premises for home grown fodder and availability of firewood from the pruning activity frees up their labour for other productive income generating small enterprises.

In addition to this, agroforestry also play a vital role in their daily livelihood in promotion of integrated home gardens and mixed farming systems, i.e. Practicing Sustainable Agriculture – mostly intercropping of seasonal and off seasonal vegetable with Tree species - Timur production.

Promoting off farm resources for economic benefit especially NTFP and herbs cultivation for instances – Timur cultivation in agroforestry system. It is believed that the NTFPs Timur based agroforestry practices would improve the welfare of women who are basically responsibly for cultivation and management of timur as a tree species in agroforestry system.

Agroforestry work well in optimum utilization of land, niche for bio-diversity conservations and as well as an increasing scope for the cultivation of off season's vegetables in river bead farming system. Not only has this but also supported in conservation and production of neglected and underutilized plant species into the production system and family nutrition that work as a safety net in the famine situation.

HVAP intervention:

Due to inadequate knowledge in sustainability, postharvest treatment and value addition of Timur, this commodity is lacking in proliferation of commercialization in project working areas. Interaction workshop carried out in Dharapani VDC among Timur growers and trader's clearly indicated that communities are inadequately geared in the knowledge of production and postharvest treatment and value addition of Timur.

Additionally, the farmers are not following the proper harvesting seasons, grading operation and post harvest handling measures that eventually reflects on the loss in volume, quality and price of the produce. It is realized that a market based solution of Timur to enhance capacities of Timur growers in production, primary processing, value addition and marketing so that the marketable volume of the Timur could be increased along with its value chain.

HVAP realized the field level problem faced by the Timur producers and came with the primary solution to mitigate the practical difficulties in harvesting and to minimize loss incurred during harvesting and post harvest storage condition. To address these burning issues, project intervened and provided harvesting equipments like hand and pole secateurs /pruning knifes, tarpaulin, staircase/ladder, Jute bags, hand gloves, seal-poline plastic sheets for drying the harvested product to the beneficiaries. In addition, field level training on sustainable harvesting, value addition and post harvesting techniques were also provided to the Timur cultivators. As a consequence, cultivators are able to sales their product in premium price and harvesting time is decreased in remarkable manner and total loss is also confined in 2.5 percent from 23 percent (Timur Base Line Survey, 2013).

Gender Role Analysis in Timur (NTFP) and Vegetable (Agriculture) Sector of Dharapani VDC of Surkhet district.

Noteworthy role of women compared with men is observed in the NTFP and Agriculture sector of Dharapani VDC. From the initiation of field work to until the production of Timur and vegetables women are playing a major role. For instance, in land preparations involvement of women is 68 percent in vegetable and 53 percent for Timur. In Timur plantation both women and men have equal role near about 70-75 percent where as in vegetable purely dominated by women, whose work force is accounted for 92 percent. In case of crop management and harvesting both are counted up to 89 percent in Timur but around 95 percent of solo account of women in vegetable is seen.

In terms of post harvest of Timur and vegetable mainly 95 percent of women are responsible. In case of product transportation to local market 75 and 91 percent of women are involve in Timur and vegetable respectively. However, in marketing of Timur men dominancy around 95 percent is commonly observed compared with women involvement (87 percent) in vegetable marketing (Author's personnel communication and group discussion with the participants during the production and postharvest management training of Timur, October 2013).

Timur as an agroforestry product, markets and women involvement

This recent study conducted at Dharapani Village Development Committee of Surkhet district indicated that women are involved in various steps of product management and marketing of Timur and are considered the domain of women; however study reveal the fact that their involvement is mostly confined to the small retail village level trade only.

A total of 101 women headed beneficiaries' household of the Dharapani VDC produced the total Timur fruits of 8458 kilogram in dry weight basis and around 296 kilogram is reported as a loss (3.5%) during the period of storage and local transportation. Present trade figure depicted that a net of 8162 kilogram of Timur fruits are traded from these household in the price of Rs.135 per kilogram and earned the Rs. 1,101,870.00. On the basis of the trade, on an average per household Timur production is 81 kilogram and of Rs.10,935.00 as an income in a year, which is slightly above than the project's speculation (average baseline income (Rs.30,000 per Household income in three years of time).

Present study of Timur production and marketing from the 101 household of the Dharapani VDC shows that women dominate the collection of the Timur fruit, drying, primary processing, post harvest storage and are also responsible for taking it to the nearest market of Dharapani of Sharahe VDC of Surkhet, where they have the least dominance (22%) in the local trade. Men concentrate on wholesale trade (78%) of Timur.

Based on the information, timur's wholesale trade involves less market time but often a lot of travel (around 6 to 7 hours on foot with the backload of 50 kilogram on one-way travel) which many women cannot undertake due to household responsibilities. Further their involvement in marketing is also limited by the mode of transport. Thus their involvement in Timur marketing is confined to early retailing trade stage of the Timur value chain.

Why Agroforestry is still not fully embedded in rural life ?

The present study provides ample evidence that NTFP incorporated in agroforestry system has the potential to offer substantial benefits to women. While their needs vary across locations, it is obvious that; they are attracted to Timur agroforestry because of minimal inputs needed for its practices, particularly with regard to cash, and the substantial benefits.

Despite the fact that agroforestry is advantageous to women, there are several limitations, which hinder them from benefitting from agroforestry enterprises. Following are the some recommendation that will support to make agroforesty more gender friendly and need to incorporate in National Forest Policy.

- Certification and reorganization of Agroforestry tree products especially NTFPs as a private poverty for Tax exemption
- Privilege for women in promotion of Agroforestry in Community Forestry area
- Community based Agroforestry system promotion
- "Agroforestry Loan" and "Land banking" especially is for Women who involve in agroforestry.

In conclusion Agroforestry should be the strategy to address poverty reduction and promotion of sustainable livelihoods and must be responsive and adaptive to local circumstances.

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Analysis of the Myth and Realities regarding the Gender Roles in Timur Value Chain

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Abstract

Study was conducted to analyse impact of project intervention in the Dharapani Village Development Committee of Surkhet District through the collection of socio-economic data and field monitoring. The study was conducted in101 households in the project intervention area. The findings of the study was conceptualised in relation to the myths related to the women. Besides "Four Myths" stated by Fortmann and Rocheleau (1984) in Plan Sierra Development Project in the Dominican Republic, two additional myths that researcher observed during her studies in mid-western part of Nepal were also analysed against the findings of this study. In Timur (Zanthoxylum armatum) value chain, in Mid-Western Region of Nepal primitive collection practice (manual), usually involving the poor, women, and children in leisure time was observed. Timur is abundant in barren lands, edge of the agriculture lands and forests. It was also found cultivated in private land by some farmers in private land and also in community and leasehold forests 220 MT is being traded along the three road corridors of HVAP project areas and around 5,000 households are being engaged in the Timur value chain. Study findings indicated that the situation of the women has been changed and were different than the myths after the project intervention. Women are not only housewives but active with significant role in forest and also NTFP value chain. They are no more passive member but active groups, cooperative members, nursery managers and not only labourer but also decision makers.

Key words: *Myth, Value chain, Timur collection, Cultivated, Private land, Women, Agriculture, intervention, Forest.*

Introduction

In Nepal, about 20,000 households are engaged in Timur *(Zanthoxylum armatum)* value chain with an annual revenue generation of about NRs 100 million from its sale. The collection practice is primitive and not scientific, usually the poor, women, and children collect Timur in their leisure time manually by hands and sticks and sometimes using traditional weapons for cutting stems and branches. In open access areas early harvesting and lopping of branches or stems prevail often resulting into fungus infestation in dried fruit and decrease in fruit production of the plant (HVAP 2013).

Timur is prominently found in the middle hills of Nepal. Along with its abundance in the barren lands, surrounding areas of the croplands and forests, however some individual farmers have cultivated Timur in their private lands and small patches of the community and leasehold forests. Altogether 220 MT is being traded along the three road corridors of HVAP project areas and around

5,000 households are being engaged in the Timur value chain. The unit cost of production of timur in the project area is estimated at NRs 47 per Kg for commercial cultivation and at NRs 40 per Kg for wild collection. The production of timur is 5 Kg dried weight per shrub and 3.5 Kg of dried seed coats. Likewise, 1.5 Kg of black shiny seeds can be obtained from 20 Kg of fresh ripen fruit (DFO, Salyan 2067/68).

Timur has a good demand since many years; however, its price has been fluctuating over years. The farm gate price of timur was NRs 1.8 per Kg in 1980, NRs 20 per Kg in 2007 and with a maximum value of NRs 110 per Kg in 2003/2004. Similarly, the price of oil has also been fluctuated between NRs 1,800 and 3,500 per Kg over the years. Nepalgunja, the headquarters of Mid-Western Region is the main route for timur export to India accounting about 95 per cent of the export from this route, although there are 27 agreed routes for mutual trade of timur between India and Nepal (Rawal, 2010). Chhinchu-Jajarkot road corridor is the principal corridor for the trading of the production and holds more than 77 per cent share of the total production of the project area. Gairi Bazaar and Botechaur of Surkhet, BaluwaSangrahi and Sallibazaar of Salyan, and Marko Bazaar and Khalanga of Jajarkot are the major local collection hubs in this corridor (HVAP, 2013).

Objective

The main objective of this study is to analyse the situation of women in Timur value chain. This study focuses on the role of women that are involved in timur cultivation as the project intervention.

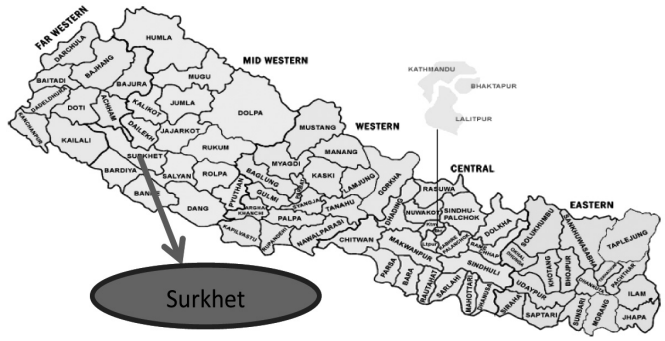
Methodology

Based on the projects monitoring reports, trimester and annual reports desk study has been carried out. However, one to one interview with leader farmers and field monitoring and observation has been conducted during study. About one hundred one households have been taken for the study and observed. The intervention to the targeted households from the project has been monitored for this study and analysis has been conceptualised correlating with the "Four Myths" stated by the authors Fortmann and Rocheleau (1984), in Plan Sierra Development Project in the Dominican Republic and two additional myths that exists in Nepalese societywhich have been observed by the researcher on her own experiences working during women farmers in the Mid-Western Region of Nepal.

Study Area

The study was conducted in Dharapani Village Development Committee, Surkhet district. Though project is working in seven districts of the mid hills, this study was carried out in Surkhet to minimize geographical challenges due to time constrains. Surkhet district falls in Bherizone in the Mid-western Region of Nepal. The geographic location of the district is at 28^0 36' North latitude and $81^0$36' East longitude. Surkhet district has 51VDCs and 1 municipility and 3parliamentary constituencies. The total area of the district is 2451 sq.km and elevation ranges from 198 meters to 2367 meters from the sea level. Birendranagar is the district headquarters. The total population of the district is 288,527 among them 142817 are male where as 145710 are female population.

Dharapani VDC, having 484 households in total consisted with 4905 population. The total population of female is 1482 and of male is 1423.The majority of the population's livelihoods depend on agriculture however seasonal migration of youth to India and to the gulf countries is highly increased since the last decade due to unstable political situation and unemployment.



Analysis and Discussions

The project aims at integrating the rural poor, especially women and marginal groups to the high value agriculture and Non Timber Forest Products (NTFP)/ Medicinal and Aromatic Plants (MAP) value chains for improved income, employment opportunities and ability to respond to market demand and opportunities based on marketing agreements with private agribusinesses. The project approach focuses on a key intervention – the development of pro-poor value chains facilitating mutually beneficial and profitable production and marketing arrangements between producers of high value commodities and agri-business (HVAP, 2012). Therefore, project has targeted to include at least 60 percent women. Fortmann and Rocheleau stated only four myths regarding women but there are several myths still exist in Nepalese society. In relation to project intervention, this paper here dealt with six myths and discussTimur value chain in terms of gender and role of women with analytical information on realities against these six Myths.

Women as housewives

The first myth is that women are just housewives. In many, if not most, rural societies they are, in fact, farmers; often they bear the major or sole responsibility for food production. Region by region, country by country, ethnic group by ethnic group, detailed studies have documented the point that women's labour and women's decision-making are absolutely crucial to agricultural production and development (FAO, 1982). In the case of Dharapani VDC of Surkhet, almost all production related works such as field preparation, planting, weeding, trimming as well as nursery to bush managing have been done by women farmers. Project had identified and selected 101 women as primary beneficiary for timur cultivation/production. These women were prioritised for primary production to sustain supply chain of timur value chain development.The reality was that women were the primary producers who were contributing their labour and time besides fulfilling responsibility of housewives. If Timur case is compared with the other vegetable production system, in Timur plantation both women and men have equal role i.e. near about 70-75 percent where as in vegetable farming women are mainly involved in plantation with contribution up to 92 percent. If crop management and harvesting is analysed, both men and women contribute up to 89 percent in Timur while in vegetable it is about 95 per cent by women. Analysis of post-harvest of Timur and vegetable indicated that women's contribution is 95 percent.

The findings clearly indicated that women have very much work load as they are fulfilling role of housewife as well as contributing in income generation of the house. These findings helped to

understand women's drudgery and to address this situation the project had provided harvesting equipment like hand and pole secateurs /pruning knives, tarpaulin, staircase/ladder, Jute bags, hand gloves, seal-poline plastic sheets for drying.

Forest products as the domain of men

The second myth is that only men are users of and responsible for tree management. In fact, women are the primary users of forestry products such as fuel-wood, wild foods and fodder. Wood et al. (1980) noted that women "are primarily responsible for wood collection and utilization and often the initial establishment and tending of the wood stock around the village". Bennett (1981) found that 78 percent of the fuel collection in Nepal was done by women, with 84 percent done by women and girls combined. In 1980, the Expert Group on Women and Forest Industries of the UN Economic and Social Commission for Asia and the Pacific reported that as much as two-thirds of the time collecting fuel-wood was spent by women (ESCAP, 1980). Even in comparison with this myth, the reality found by the project indicates that out of 101 women,23 women entitled membership as Timur Cultivators in Community Forestry located at Dharapani.Likewise,15 women are holding the key position in each group of cultivators where 7 groups of timur cultivators have been formulated by the community to maximise benefits and arrange equitable sharing.

Men as heads of households

The third myth is that every woman is a member of a male-headed household but not decision maker themselves. In fact, quite good numbers of household are headed by women and study indicated that there is increasing trend in household leadership taking by women.The leadership transfer trend is either due to increased awareness or due to events such as death of a spouse, divorce, desertion or abandonment, or of social trends such as male outmigration. In the study area, about 70 per cent of men out-migrated to India or to the Gulfcountries so 23 women were the de facto household head in the village. These women were free to make decisions not only on agri-crops but also on property, savings and other activities. Women were managing their household expenses which were earned from Timur along with other vegetable crops such as potatoes, green leaf, tomatoes etc. Analysis of household expenditure to learn decision making by women on various household expenses indicated that about 70 percent of the income is spend on food and children education was their next priority.

Women as passive community members

The fourth myth is that women are passive members of the community in which public influence and public action is a sphere restricted to men. March and Taqqu (1982) have documented the important influence on women's informal associations in both the private and the public sphere. Women, both individually and in groups, have private influence on public action by men and undertake public action themselves. It was found that in study area, 23 women are in key position on cooperatives so that their decision count and help to steer board of executives. They have demonstrated their ability of leading the community group maintaining good governance. Not only in study area but also in whole country, women are given responsibility of the "treasure" in almost all groups/cooperatives due to their honesty and transparent/accountable nature. Project helped

to established small women-producers group and linked them with farmer's cooperative to make the small women farmers group more sustainable and also to provide access to opportunities and benefits from the farmer's cooperatives. Similarly, women were also provided series of trainings on nursery management, plantation, bush management, post- harvesting etc. In the project site, 60–80 per cent of these women are considered as processers and almost 70 percent women are the manual transporters while the domain of the overall marketing (almost 95 percent) is still captured by men even in Timur value chain and only 5 per cent of women are playing the role of marketers dealing with the traders and circulating price information for the producer of their respective groups and cooperatives. Though women are sustaining value chain of Timur as active chain actors such as producers, processors, marketers still more assistance needed to bring them to the large trading market for providing more benefits.

Women as domestic labourer

The fifth myth of our society is that women are domestic labourer. Situation of women is worse if we peep inside the society of the mid-western part of Nepal where women are the domestic labour who are not paid or get any other benefits for their work. Earlier this situation used to exist even in the project district. After project intervention, this myth is no longer relevant in the project district. Now women are earning from various incomes generation activities and are also entitled to various benefits. Women are also making decision on spending of money for household need.

Women as reproducer

The sixth myth is that women are only the reproducers i.e. only to reproduce children to give continuation to generation. Project provided training to women on various activities including nursery management. But now women besides fulfilling reproductive role are also producing sapling/seedlings by managing nurseries, nurturing plants, pruning bushes and manage various natural resources. Other roles that women are fulfilling have already been mentioned above.

Conclusion

This study indicated that women are involved in various steps of product management and marketing of Timur and is considered the domain of women. Study alsorevealed that women are not only confined to the household activities but also contributing to production, collection, harvesting, processing and trading of NTFP (eg Timur) and agriculture products. It is also learned that women's role in trade was only confined to the small retail trade but not in the big markets. This indicates that still more need to be done to bring women in big market and thereby increase benefits to them. Moreover, this study helped to clarify myths regarding gender role in our society and confirmed that women are the main actors of the NTFP (Timur) value chain and provided justification of project interventions. Study also clarified leadership roles played by women in various activities and also de facto decision makers as household head.

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Silvo-pastoral agro-forestry system: A sustainable model for shifting cultivation management and livelihood improvement of the rural poor

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Abstract

Leasehold Forestry and Livestock Program has been piloted in shifting cultivation areas of Jhirubas VDC of Palpa district since 2010. A total of 227 ha of shifting cultivation areas have been handed over to 19 Leasehold Forest User Groups involving 227 poor households of ethnic communities as leasehold forests. The people were persuaded implementation of leasehold forestry program through social mobilization. Silvopastoral agro-forestry (cut and carry) model has been practiced in the shifting cultivation areas. Broom grass a native species having multiple benefits was chosen for first year intervention. Multipurpose tree species were planted in the second and the third year. Land development coaching was provided to both men and women members of each household using sloping agriculture land technology just before plantation. In contrary to other agro-forestry model, hedge rows have become the key areas of concern that generate major income. The leasehold group members have been benefited right from the first year of intervention from the sale of broom grass panicles. Each household has bagged cash income of over NRs 121,000 only from the sale of panicles. With the production of huge quantity of fodder in the lease land, women have been able to save 3 hrs a day in collecting fodder. Increased availability of fodder has not only reduced the drudgery of the women but also increased the production of meat and milk ensuring food security of the group members. Being very good raw material for paper pulp, the broom stalk has the potentiality to generate additional income. The multipurpose tree species planted in the lease land provides benefits in medium and long term. The diversification of the products minimizes the risk of market failure. In view of all these benefits, the people have demanded the extension of the model in the neighboring VDCs. Other development agencies have also joined hands with leasehold forestry mainly for developing physical assets. All these interventions have resulted increase in green coverage conserving soil, easy access to market and rise in income. In conclusion this model has demonstrated that right choice of agro-forestry model can transform degraded land into productive use improving the livelihood of the rural poor.

Key words: *Agro-forestry, Silvo-pastoral, Leasehold Forestry, Livelihoods, Shifting cultivation*

Leasehold forestry for the poor

Leasehold forestry for the poor is a participatory model of forest management designed to reclaim the degraded forests and improve livelihoods of the poor and marginalized households. In this

model small plots of national forest land are provided to the group of poor households for a period of forty years with the purpose of operating agro-forestry practices (GoN, 1993). The group protects, manages and utilizes the products of the leasehold forests as specified in the operational plan (GoN, 1995).

Piloting leasehold forestry in shifting cultivation areas

Figure 1: Beneficiary household

Leasehold forestry has been piloted in the shifting cultivation areas of Palpa district with the technical support of Food and Agriculture Organization (FAO) since 2010. Jhirubas Village Development Committee (VDC) was selected for piloting with the decision of the District Program Coordination Committee. A total of 227 hectares of shifting cultivation areas have been provided to 19 Leasehold Forest User Groups (LFUG) involving 227 poor households (TA-LFLP 2010). Large blocks of shifting cultivation areas still exist in the neighboring VDCs of Palpa and Nawalparasi.

The people of Jhirubas were living in extreme poverty. About 85 percent of the households had less than six month food security. Average size of land holding was 0.4 hectare per household. Most of the households were dependent on the shifting cultivation area for their livelihood. The shifting cultivation area being highly degraded its production did not contribute much in food supply. Most of the households were ethnic *Magar* community (86.7 percent) and few were Dalits (3.5 percent). Their literacy rate was very poor. Only 53.3 percent were literate. The average number of livestock holding per household was 13.6 (TA-LFLP, 2010). They were freely grazed in the forests resulting further degradation of the forest.

Figure 2: Shifting cultivation area

Silvo-pastoral (cut n carry) agro-forestry system in the piloting areas

Silvo-pastoral cut n carry agro-forestry system was practiced after thorough analysis of the following situations of the piloting areas:

Land availability: The prerequisite for the implementation of any agro-forestry system is land. The target households had little or no private land available for agro-forestry practices but they had large blocks of shifting cultivation areas for this purpose. Even though they did not have legal rights over such land they have been cultivating cereal crops by tradition for their subsistence. Initially they were reluctant towards leasehold forestry but later as they knew about the benefits from leasehold forestry they convinced and joined the program. The poor who have little or no shifting cultivation areas were also provided equal access to the lease land.

Sources of income: Agriculture, livestock and wage labor were the first, second and third source of income of the people residing in piloting areas (TA-LFLP, 2010). They have been practicing agro-forestry since generations. They have accrued traditional knowledge on crop cultivation and animal

husbandry. Being labor intensive agro-forestry practices can retain youth force moving out of the village. Considering all these facts it was realized that small support on planting materials and technical knowhow could bring significant changes in the livelihood of the people.

Economic opportunities: Like other remote rural setting, there were limited economic opportunities in Jhirubas. Subsistence agriculture was the main stay of the life. Learning from the traditional practices it was realized that applying broom grass based large scale agro-forestry practices opens door for employment and income. Large work force can also be consumed in planting, weeding, harvesting and processing of the products.

Outmigration of youths: In absence of economic opportunities, large youth population has been migrated out of the village in search of employment and income. If this trend continues, it might invite serious social, cultural and economical consequences in rural setting. Silvo-pastoral agro-forestry system has the potential to generate many economic opportunities.

Soil erosion: Shifting cultivation in hill slopes has turned into annual cropping that has accelerated environmental consequences such as soil erosion. Planting hedge crops along the contour with alley of multipurpose tree species not only reduces the soil erosion problem but also supports enhancing the environmental services.

Workload to the women: The household chores such as fetching water, collecting fodder and firewood are socio-culturally associated with women in rural Nepal. Jhirubas was not the exception. With the depletion of forest resources women have been affected the most. They had to walk longer distances just to collect few liters of water and a bundle of fodder or firewood. This had increased the workload of the women who were already overburdened. This resulted delay in cooking food. As a result the children were always late in going to the school. Moreover, with the migration of the youth (mainly the men) women also have to do the job of the men. This has further added the workload to the women.

Therefore an intervention that brings balance between environmental improvement and the needs of the people was most essential.

Strategic Approach

Various strategic approaches were adopted while piloting agro-forestry model in Jhirubas, Palpa. All these approaches have played crucial role for the successful implementation of the model.

Social mobilization: While going for new intervention, it is necessary to build rapport with the local people and win their trust. Once building the trust with the local community it would be easy to get their support in implementing the activities. Therefore social mobilization has been taken as an integral part of the intervention.

Utilization/promotion of the traditional knowledge: The local people have been cultivating broom grass in their private land since generations. They have gained some knowledge on broom grass cultivation techniques. They also knew the importance of broom grass for their livelihood improvement. Therefore broom based silvo-pastoral agro-forestry model was piloted to enhance, utilize and promote their traditional knowledge.

Participation of women: Women have very close relationship with the forests. They are dependent on the forests for fodder, firewood, leaf litters, wild fruits etc. Therefore they are the key actors in implementing forestry activities. It is hard to succeed without their participation. For this reason women should be in the forefront in making decision. An enabling environment has been created for women so that they can decide themselves what to plant where to plant when to plant as per the technical prescription of the field technicians. Moreover both women and men from each household have been trained on land development techniques. Strategy has been taken to increase the women in the key positions. As the people have been cultivating maize and millets in the lease land for decades, it would be a difficult to stop it at the first instance. Therefore they were allowed to do intercropping for the first year. This has been the motivating factors for the groups until they start earning from brooms.

Livelihood improvement planning: Livelihood improvement has been a multi-sectoral matter of concern. Unless agencies working in different sectors do not coordinate and collaborate to each other for the development of all the five resources i.e. natural, physical, human, financial and social; livelihood improvement of the poor is not possible. Household level livelihood improvement plan needs to be prepared to get all the agencies together for common goal. Therefore livelihood improvement plan of all the households involved in implementation of this model have been prepared incorporating the activities that help for the development of all the five resources.

Short term investment with long term vision: The poor cannot wait for long to get return from their investment. Moreover they do not want to put themselves on risk investing for longer term. Therefore they have been supported first with short term income generating activities such as broom cultivation that starts generating income after six months.

Joint planning and monitoring: Joint planning with other development agencies helps to get their support in implementing livelihood improvement plan. Therefore it was initiated in Jhirubas involving heads and representatives of the development agencies right from the implementation level. Joint monitoring was also practiced involving all the collaborating partners. This has been very useful to the group members who got opportunity to discuss their issues and concerns with the heads or representatives of concerned agencies right on the spot. The development agencies also got opportunity to observe the field activities and discuss with the group members about the effectiveness of their support. This has also helped the group members to establish direct linkage with various development agencies for the future support.

Coordination and collaboration: A lot of resources can be regenerated in coordination and collaboration with other agencies. Coordination meetings were organized at field, district and central level to discuss on the areas of collaboration and kinds of support that each agency can provide to the groups. With those coordination meetings; the groups have been able to get supports in the form of cash, kind and technical inputs from various agencies. Field facilitators were assigned to regularly follow up to fulfill the commitments of the development partners.

Species diversification and multiple products: Planting multiple species not only reduces the risk from monoculture but also minimize the investment risk providing various products. In Jhirubas, broom grass has been planted intermixed with other non-wood forest products and multipurpose tree species. If the market of one product goes down, this will be compensated by another product. If the market of broom panicles slows down the users will be compensated from other species such

as Timur (*Zanthoxylum armatum*), Tejpat (*Cinnamomum tamala*), Kurilo (*Asparagus recemosus*) etc. Broom grass itself produces multiple products such as panicles for broom making, stalks for paper pulp and leaves as fodder. In case market of broom panicles fails there is still income from leaves and the stalks.

Major interventions

Formal and informal meetings: Several formal and informal meetings were organized with the local people and Village Development Committee before actual implementation of the work. They were well-informed about the objectives and importance of the intervention. They were also clarified what kinds of support they receive and what they have to contribute if they want to see the intervention implemented in their village. The intervention was initiated only after receiving the commitments of local people.

Group formation and their networking: The poor households were identified through well being ranking. The groups were formed involving 12 to 15 households in a group depending upon the area of the shifting cultivation and number of poor households in the village. A small group of poor people would not be able to resist the pressure from the non-members unless they unite with other groups and work together for the common causes. Considering this fact, all the 19 groups in Jhirubas have been networked in Kauledanda intergroup. The intergroup has acted as the umbrella organization of all the groups.

Institutional strengthening: The functioning of the local level institution determines the sustainability of an intervention. Therefore supports have been provided for the institutional strengthening of the groups and intergroup. Women were encouraged to take decision making position through awareness raising campaign. The responsible persons of the group and intergroup have been trained on leadership development, governance, gender and social inclusion etc. The groups were also provided establishment support such as office materials initially.

Figure 3: Seedling production

Production, purchase and distribution of planting materials: Intervention area being very remote emphasis have been given to produce seedlings locally instead of purchasing from outside. This not only protects the planting materials from being damaged during transportation but also saves time and cost. Rhizomes of broom grass (*Thysanolaena maxima*), seedlings of Kurilo (*Asparagus recemosus*) and multipurpose tree species such as Tejpat (*Cinnamomum tamala*), Timur (*Zanthoxylum armatam*), Lakuri *(Fraxinus floribunda)* were produced/purchased and distributed to the LFUG members. More seedlings of non-wood forest product (NWFP) species such as Alainchi (*Elettaria cardamomum*) and Kurilo have been produced in the nursery for plantation in the shifting cultivation areas.

On site coaching on land preparation and plantation management: Classroom type of training providing only the theoretical knowledge does not help much to the group members having poor education level. Therefore on site coaching on land preparation including sloping agriculture land technology (SALT), plantation, weeding and harvesting have been provided to 354 group members.

Plantation along the contour: The main focus was given in planting broom grass as it starts generating income right from the first year. About 2.5 million sets of broom grass have been planted at 1m by 2m spacing along the contour as hedge rows using sloping agriculture land technology (SALT). A total of 230 thousand various multipurpose tree species such as Tejpat, Lakuri, Pakhuri (*Ficus glaberrima*), Utis *(Alnus nepalensis),* Timur, Ipil Ipil (*Leucaena leucocephala*), Tanki (*Bauhinia purpurea*) have been planted from second year onwards as an alley crop. A total of 227 ha of shifting cultivation area have been planted with broom grass, other NWFP and multipurpose tree species.

Figure 4: Contour lining before plantation

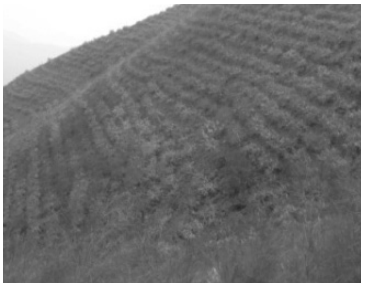

Figure 5: Plantation along the contour

Protection of natural regeneration: Due to protection from grazing and the forest fire the natural regeneration of Chilaune (*Schima wallichii*), Lakuri, Kutmiro (*Litsea monopetala*), Khasreto *(Ficus hispida*) have been emerging abundantly from the root system that remained undisturbed even at the time of slash and burn. These valuable species have been protected with proper treatment for long term benefits.

Livestock development including animal health services: Livestock especially the goat has been the major source of income for many rural poor. Considering this fact, the first year intervention was focused on plantation of fodder and forage species in the shifting cultivation areas. With the production of huge quantity of animal feed in the second year, livestock development activities were initiated by distributing a pair of goat to each household. Stall feeding has been promoted for environmental conservation. Animal health services have been provided through well trained village animal health workers.

Figure 6: Goat rearing

Formation of cooperative: Cooperatives are the rural finance institutions that enable its members to realize economic benefits that they could not otherwise achieve alone. Kauledanda cooperative has been formed involving all the households of 19 groups. Representatives of all the groups have been involved in the board of the cooperative. The executives of the board were trained on financial management, leadership development, governance and gender and social inclusion. The cooperative has been involved in the marketing of the forest and agriculture products such as broom and ginger. Each member has individual saving account in the cooperative where they can deposit their saving on monthly basis. Besides this each group has its saving account in the cooperative. The money collected in the cooperative has been mobilized within the group members for various income generating and emergency needs.

Figure 7: Women in decision making

Changes brought by agro-forestry model:

Silvo-pastoral agro-forestry model has brought major changes in the livelihoods of the people and ameliorate the environment vigorously.

Women participation in the group: Women participation in the group meeting has increased to 55 percent and in key positions (chairperson, secretary and treasurer) to 40 percent due to various awareness campaigns and the trainings (Field survey, 2013).

Time saving for fodder collection: Women have very close association with the forests in rural areas. They go to the forest almost every day for fodder, firewood, leaf litter and NTFP collection. Before the intervention they had to spend up to 6 hrs just for the collection of a bundle of fodder but they have been able to collect the same amount of fodder in 45 minutes (Field Survey, 2013). They have been using the time thus saved in various income generating activities. They have been able to get cash in their hands. Moreover women have been able to cook food timely so that their children reach the school at right time.

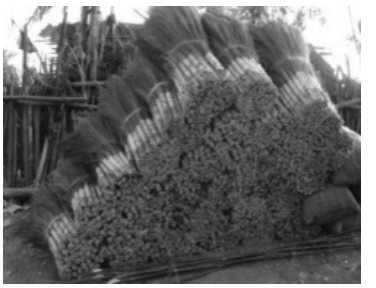

Figure 8: Broom ready for sale

Income level of the users: The income level of the users has been raised from the sale of panicles of the broom grass. They have been gaining cash income right from the first year of intervention. The panicles of the broom grass have become the main source of income of the group members. Each household has earned NRs 121,205 in a year only from the sale of panicles produced in one hectare of shifting cultivation area (Table 1). Besides they have been benefited from the leaf that is good fodder for the livestock. After four years they will get additional benefits from other NTFPs and the multipurpose tree species. Unlike other models hedge rows have become the key areas of concern that generate major income perpetually.

Table 1: Production and income from the broom grass cultivation (source: Field survey)

S. No.	Income source	Broom grass cultivation		Remarks
		Production (green biomass in kg)	Income (NRs)	
1	Panicle	1865	121205	@ Rs 65 per kg
2	Stalk	5016	20,065	@ Rs 4 per kg
3	Leaf	4814		Consumed as animal feed
Total			**141,270**	

Improvement in the livestock productivity: With the increased production of the fodder, enough foodstuffs have been available for the livestock. The improvement in the nourishment has directly impacted on animal health resulting increased production of milk and meat.

Soil conservation: The broom grass planted along the contour has conserved the soil from erosion. The incidence of landslides has been reduced to zero. The increased greenery in the intervention area has conserved the soil moisture content allowing natural regeneration to grow. The downstream

water sources have been recharged and water has been available round the year. This has decreased the burden of the women by reducing the time for fetching the water.

Livelihood improvement: Silvo-pastoral agro-forestry model practiced in Jhirubas has been able to regenerate natural resources that have direct impact on livelihood of the people. Impressed by this agro-forestry model, other development agencies joined hand by providing support in various development activities such as electrification, drinking water supply, biogas installation, collection center establishment, informal education, health campaign, toilet construction etc. Over NRs 5 million have been pooled in coordination and collaboration with other development partners. This has widened the livelihood strategies and income sources of the people.

Award: Recognizing this intervention as a good model for mountain development, Ministry of Forest and Soil Conservation has awarded national level Mountain Development Award in three consecutive years. Likewise District Development Committee (local government) has recognized this model as the best development initiatives in the district.

Opportunities

Up-scaling the model: Large shifting cultivation areas prevailing in the neighboring VDCs and districts are highly potential for up-scaling the model. Motivated from the field visit of Jhirubas, the people from neighboring VDCs and districts have requested to expand the piloting in their Village Development Committee.

Multiple benefits: Intensification of species and diversification of the products offers multiple benefits. The annual production of panicles from intensive plantation of broom grass has exceeded 400 tons (green) in Jhirubas that are being sold out raw without processing. If the people trained on broom making as per the market needs, they would be able to get additional income. Likewise the stalk of the broom is very good for paper pulp (Fetalvero 2012). Huge quantity of the broom stalk produced in the intervention site if used for paper making it fetches high price. Broom grass is also a good fodder in the sense that it remains green even in dry season. The annual production of leaf biomass has exceeded 1000 tons (green). If used for animal feed either fresh or in the form of silage it generates additional income from animal husbandry. More benefits can also be obtained from other NWFP and multipurpose tree species planted there.

Mitigating climate change effects: The shifting cultivation areas have been planted with varieties of multipurpose native species involving the forest dependent communities. It has not only reduced the rate of deforestation and forest degradation but also has limited the pressure on forest resources. All these activities have led to enhancement of carbon stocks in the intervention areas. As it addresses the REDD+ objectives this agro-forestry model has high potential in mitigating carbon emission.

Resource generation: Looking at the success of this model, more agencies have shown their interest to collaborate in those development activities that supports livelihood improvement of the rural poor. Regular coordination and follow up with those agencies is important to pool the resources.

Key lessons

Lesson learned from this intervention are as follows:

- Rehabilitation of degraded forests is possible through implementation of proper agro-forestry model in participation of forest dependent rural poor especially the women.
- Livelihood improvement planning is the best tool for holistic development in coordination and collaboration with other development agencies.
- Silvo-pastoral agro-forestry model is the best choice to reduce drudgery of the rural women.
- Start from small short term intervention with medium and long term vision that leads to the success.
- Species and product diversification secures investment.
- Single development initiative proliferate multiple benefits.

Recommendations for further improvement

Up-scaling the model: Considering land availability and respecting the interest, demand and need of the people, this model should be up-scaled in the neighboring VDC and districts with participation of the local community.

Value addition and marketing of the products: Large quantity of broom panicles, stalks and leaves have been produced in Jhirubas. More products are expected from other NWFP and multi-purpose tree species in few years time. The broom panicles have been sold out without processing as raw materials for broom making. Only small portion of the leaves have been used to feed the livestock. Small quantity of broom stalk has been sold out to make the handle of the broom. The rest have been consumed as firewood. If semi-processed or processed to make paper pulp, the stalk fetches higher price and also generate employment to the rural poor. Therefore it is recommended that the group members should be trained on semi-processing / processing of the products and supported for enterprise development. The local institutions such as the group and the cooperative should be capacitated on marketing the products.

Social mobilization: The success of any intervention depends upon the field facilitators who always remain in touch with the group and provide regular support. Therefore it is recommended to develop and train local resource person and regularly monitored their performance. The local resource person being an inhabitant of the same area provides support to the group continuously even after the project.

Support livelihood improvement plan: It would be difficult to improve the livelihoods of the rural poor unless the problems/issues related to all the five capitals are addressed. This is possible only through the preparation and implementation of livelihood improvement plan in coordination and collaboration with other development agencies. It is recommended that coordination meeting with development agencies should be regularly organized to discuss and decide on the support in implementing livelihood improvement plan. The lead agency should frequently follow up the progress on the decisions. Organizing joint monitoring with development agencies provides

opportunities both to the users and service providers to share their knowledge and experiences. This also helps in establishing the linkages between the users and the service providers for future support.

Conclusion

Many professionals used to argue why degraded forests to the poor people ? Their argument was based on the philosophy that the degraded forests need a lot of investment in the beginning to bring it back to productive use. The poor would not be able to invest huge resources and wait long time for the benefits. In such a case, how can a poor people be motivated ? The silvo-pastoral agro-forestry model described in this paper has answered all the above questions. This model has demonstrated that right choice of agro-forestry model can transform degraded land into productive use improving the livelihood of the rural poor.

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Public and Institutional Land Management: An Agroforestry System for Livelihood Diversification in Western Low Land, Nepal

Sushma Bhattarai‡ and Basant Pant§

Abstract

People in western low lands of Nepal are facing increasing livelihood problem. Mostly affected are poor and landless people, living in highly vulnerable areas to the effect of climate change, with limited livelihood opportunities and devoid of access to forest resources. Studies have suggested that agroforestry system practiced in public and institutional land (PIL) have potential to improve the livelihood condition of poor people, through ensuring their access to forest resources and livelihood diversification. However, most of the studies to dates have been focused on improving livelihood based on existing forest, and scientific literatures regarding agroforestry in PIL to date are scant. Limited attempts have been initiated in the ground which is far below their potential. Western low land of Nawalparasi district was chosen for the study as it consists of community based agroforestry management initiatives in PIL areas from eight years. Field observation, semi-structured and key informant interviews were the main methodological tools used for the study. Besides, review of project documents, reports and various other scientific materials was done. Empirical evidence demonstrated that community based agroforestry system in PIL has made landless poor self reliant by providing sustainable forest products flow and generating cash income. People have improved their livelihood condition through diversifying their income opportunities such as fish farming, vegetables and other cash crops. Therefore, this study suggests that, in order to help poor to escape poverty; livelihood diversification, sustainable PIL management strategy is required.

***Key word**s: public and institutional land, agroforestry system, vulnerable, community based management, livelihood diversification*

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ANNEX 1 Program

Women in Agroforestry

28th to 29th November 2013

Hotel Manaslu, Lazimpat, Kathmandu

1st Day Schedule (28 November 2013)

Inaugural Session		
Time	Content	Responsible Person
8:30 -9:15	Participants and Guests arrival/ Buffet Hi Tea, Registration and Taking seats	All
9:15 -9:20	Welcome Speech	Prof. Dr. Abhoy Kumar Das President, Nepal Foresters' Association(NFA)
9:20- 9:25	Inauguration by Chief Guest	Honorable Minister of Forest and Soil Conservation Mr. Tek Bahadur Thapa Gharti
9:25- 9:30	Introduction of the workshop	Dr. Swoyambhu Man Amatya, Deputy Coordinator, Agroforestry Division, IUFRO.
9:30- 9:40	Remarks	Ms. Indira Shrestha, Former Member, National Planning Commission, Govt. of Nepal and Chief Executive, Shtrii Shakti.
9:40- 9:50	Remarks	Dr. K. C. Paudel Secretary, Water and Energy Commission Secretariat, Govt. of Nepal
9:50- 10.00	Remarks	Mr. Jaya Mukunda Khanal, Secretary, Ministry of Agriculture and Development
10:00-10:10	Speech of Chief Guest	Honorable Minister of Forest and Soil Conservation Mr. Tek Bahadur Thapa Gharti
10:10- 10:15	Vote of thanks	Mr. Kumud Shrestha, Vice President, Nepal Foresters' Association.
10:15 – 10:25	Closing Remarks By Chairman of the session	Dr. Ganesh Raj Joshi, Secretary, Ministry of Forest and Soil Conservation
10:25- 10: 45	Tea Break	All

Women in Agroforestry
28th to 29th November 2013
Hotel Manaslu, Lazimpat, Kathmandu
First Day (28 November 2013)

First Session: Paper Presentation		
Chairperson: Mr. Krishna Acharya, Chief Planning Officer, Ministry of Forests and Soil Conservation		
11:00- 11:20	Flower Seed Production for Remunerative returns Under Poplar Based Agroforestry System	Ms. Sangeeta Rani, India
11:20- 11:40	Innovative agri-silo-pastoral model developed for growing trees and ground fodders in the terrace risers of cropping lands	Dr T.P. Barakoti, Chief of Division Agricultural Research Council (NARC), Outreach Research Division (ORD), Nepal.
11:40- 12:00	Unleashing Development Potential by Promoting Community Service providers in demand led agroforestry service provision	A.K. Osman Haruni, Program Coordinator STROMME FOUNDATION BANGLADESH
12:00 – 12:20	Agro-forestry Management and Practices in the Middle Hills: Linkages to Improve Livelihood and Empowerment of Rural Women in Nepal	Arun Sharma Poudyal Visiting Faculty Kathmandu Forestry College
12:20-13:00	Discussion	All
13:00- 14:00	Lunch break	All
Second Session: Paper Presentation Chair Person: Dr. K. C. Paudel Secretary, Water and Energy Commission Secretariat		
14:00- 14:20	Potential and Realization of Carbon Sequestration in Agroforestry	Rajni Sharma, India
14:20-14:40	Agro-forestry - In the lenses of Gender Prospective: Sustainable Vegetable & NTFPs production in Dharapani VDC, Surkhet district.	Mr. Giridhar Amatya Agroforestry and NTFP Expert HVAP, Surkhet
14:40-15:00	Species Selection for Agroforestry System Development and Management	Murari Raj Joshi, Kathmandu Forestry College, Koteshor, Nepal
15:00-15:20	Empowering women in Agroforestry: For sustainable livelihood and tackling climate change	Mr. Bishnu Hari Paudyal, National Coordinator Nepal, RECOFTC.
15:20 -15:45	Discussion	All

15:45-16:00	Tea Break	All
16:00-16:20	Agroforestry in Nepal: Women's perspective	Dr. K. M. Bajracharya, Academician, Nepal Academy of Science and Technology.
	Silvopastoral Agroforestry System: A Sustainable Model for Shifting Cultivation Management and Livelihood Improvement of the Rural Poor	Mr. Bala Ram Kandel Leasehold Forestry Specialist Food and Agriculture Organization of the United Nations (FAO)
16:40 – 17:00	Discussion and closing of the day	All
18:00-	Dinner (Hotel Manaslu)	All invited guest and participants

2nd Day (29 November 2013)

First Session: Paper Presentation Chair Person: Prof. Dr. Abhoy Kumar Das		
8.00-9.00:	Breakfast	
9:00- 9:20	Practice of Agro-forestry for secure livelihood food security in the Rim of the Kathmandu Valley: A look at Madhevasthan, Matathirtha and Machegoan Villages**.**	Deepak Dorje Tamang, Director SEARCH Nepal.
9:20-9:40	Agf-in the LGP and Case study of Sus vegi and NTFP -Timur Production in Dharapani VDC, SKT district.	Ms. Pratibha Rijal, GESI HVAP, Surkhet
9:40-10:00	Agroforestry and Women willingness and compulsion for livelihood (A case study of Kavre palanchok distirct of Nepal)	Dr. Suman S. Bhattarai, Associate Professor, Tri-Chandra College, Kathmandu
10:10-10.50	Discussion	All
10:50-11:15	Closing of the workshop	All
11:15-11:50	Tea	All
12:00	Depart for Dabur Nursery, Kavre	All
13:00	Arrive Kavre	All
13:00 -14:00	Lunch	All
14:00-16:00	Visit Dabur Nursery	All
16:00	Depart for Hotel Manaslu	All
17:00	Arrive for Hotel Manaslu	All

Annex 2 : List of participants

List of Participants (In the Dais)

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