

Proceedings of a national workshop Mainstreaming Biodiversity and Ecosystem Services into Community Forestry in Nepal



Jointly Organized by
**Department of Forests (DoF),
Federation of Community Forestry Users Nepal (FECOFUN)
and Bird Conservation Nepal (BCN)**





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FOREWORD

Community Forests (CF) have been recognized as one of the successful management modalities in forests and biodiversity conservation in Nepal. It has been very effective in restoration of degraded forests and wildlife habitats to improve sustained supply of ecosystem services and resilient capacity of forest ecosystem to climate change.

Study of the success stories shows that benefits from CF can be maximized by improving its management capacities. The CF Operation Plans are more focused towards the production of timber and non-timber products with little concern to biodiversity conservation issues. This may be due to lack of awareness among users about biodiversity and ecosystem services.

In this outset, the workshop on "Mainstreaming the Biodiversity and Ecosystem Services into Community Forestry in Nepal" was organized in appropriate time by Bird Conservation Nepal and Birdlife International. I believe that this workshop was very successful to energize scientists, policy makers, academicians and practitioners to integrate biodiversity and ecosystem services into community forestry operational plans. I am sure this proceeding will add value in improving biodiversity conservation and ecosystem services in community forests of Nepal in the days to come.

Finally, I would like to appreciate the paper contributors and moderators for their tireless efforts to make this workshop successful. I am also very grateful to distinguished participants from DoF, FECOFUN, Bird Conservation Nepal and Darwin Initiative for their incredible deliberation in this workshop.

Resham Bahadur Dangi
Director General



Bird Conservation Nepal

नेपाल पंखी संरक्षण संघ

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BCN would like to acknowledge the editors namely Parbat Raj Thani, Dr. Rajendra K.C. and Dr. B.K. Sharma who provided their valuable time in making corrections and providing suggestions on the papers for their rectification.

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Narendra Man Babu Pradhan, Ph. D.
Chief Executive Officer



Painted Stork by Jyotendra Jyu Thakuri

SECTION I

Mainstreaming Biodiversity and Ecosystem Services in Community Forestry in Nepal

Dadhi Lal Kandel¹ and Krishna Prasad Pokhrel²

Abstract

Community Forestry (CF) is recognized globally as an innovative, people-centered, effective and successful model for forest resource management which was evolved in the late 1970s in Nepal as part of an effort to curb the widely perceived crisis of Himalayan Environmental Degradation. The first regulatory intervention was taken place in 1978, a comprehensive programmatic approach was implemented under the *Master Plan for Forestry Sector in 1989*. Undoubtedly, a significant progressive and devolutionary legislation was enacted in 1990s. A broader consultation with stakeholders (such as CF national WS) is also a critical factor of CF development in Nepal. Community forestry has brought a considerable amount of quantitative and qualitative positive changes in biophysical condition of forests as well as in community / social development. It is quite successful in achieving first generation goals (i.e. restoring and regenerating forest and fulfilling the local people's subsistence needs of forest products); however, second generation goals (sustainable forest management, good governance and livelihood support) and third generation issues (poverty reduction, silvicultural system-based forest management, CF-based enterprise development, payment for ecosystem services etc.) yet to be achieved to a great extent. So far, around 1.8 million ha. (31% of total national forest area) has been handed over to 18960 CFUGs in which around 2.4 million HHs have been directly benefited. In addition, it possesses a huge potential of producing timber and non-timber forest products and environmental services. Properly tapping these potentials, we can generate considerable amount of financial capital and huge number of employment which ultimately supports people's livelihood and poverty reduction. Some crucial challenges such as exclusion and inequitable distribution of benefits, enhancing and optimizing forest productivity and production, tapping intangible benefits, state-restructuring and future of community forestry, forest enterprise development, coping with new emerging issues etc. are still to be addressed. As change dynamics always creates some new issues in every field of development, community forestry can not be an exception to climate change management and REDD+, linking CF to pro-poor program, private sector involvement in forestry enterprise, biodiversity conservation, landscape connectivity and human-wildlife conflict management; payment for ecosystem services, governance reform, future of CF in federal restructuring etc. are some emerging issues to be managed and addressed. The basic principle of community forestry is *learning by doing*. Due to their collective efforts, local-level community-based institutions are more effective to produce desired results if the state ensures them rights over resources. This is the key learning from the community forestry of Nepal.

Key words: Community Forest Management, Biodiversity, Livelihood

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1.0 INTRODUCTION TO COMMUNITY FORESTRY

Community Forestry (CF) is an innovative, people-centered, effective and successful model for forest resource management which has achieved broad global acclaim over thirty-five years. It was initially designed to arrest the alarming situation of forest destruction, improve forest condition and meet basic needs of the forest products sustainably.

Nepal is a pioneer in community forestry management which is recognized for participatory institutional innovation for empowering local communities to manage their local forest resources. This concept was initiated in the late 1970s as part of an effort to curb the widely perceived crisis of Himalayan Environmental Degradation. The CF approach evolved from the indigenous practices of forest resource conservation (Gilmour and Fisher 1991) and has come to the present shape through the learning from practices, refining over time, and legitimizing those practices (Kanel, 2008). It is considered as a new dimension, one of the most appropriate strategies and paradigm shift in sustainable forest management and good governance (Malla, 2010).

Community Forestry occupies a central place in forest management in Nepal which exist conducive policy and strategies, a well-defined regulatory framework, participatory institutions, benefit sharing mechanisms, user groups' strong network and forest tenure rights. As a consequence, it has brought many significant positive changes such as restoration of forests, increasing density and growing-stocks, enhancing ecosystem services

and increasing local participation including gender mainstreaming and social inclusion. It has further supported in promoting decentralized democratic governance; increasing income generation, supporting rural livelihood and capacity building. However, there exist still some challenges and emerging issues to be addressed.

Despite of achieving several notable positive outcomes, CF is also facing few key challenges in terms of sustainable forest management, inclusive decision making, benefit sharing, governance and livelihood support for poor and marginalized groups. Obviously, it is quite successful in achieving first generation goals, i.e. restoring and regenerating forest and fulfilling the local people's subsistence needs of forest products. However, second generation issues (sustainable forest management, good governance and livelihood support) and third generation issues (poverty reduction, silvicultural system-based forest management, CF-based enterprise development involving private sector, payment for ecosystem services etc.) yet to be addressed. In addition, equity in benefit sharing and securing forest tenure rights in changing context are also important issues. Broader consultation among the stakeholders, adequate policy dialogue based on the CF outcomes, forestry sector governance reform and equitable benefit sharing are some measures to be taken to face these challenges.

Community forestry is linked to various dimensions such as forest, communities, livelihoods, biodiversity, governance, equity, capacity building, proximity of forest and community etc. The figure 1 shows the inter-link of community forestry with different dimensions.

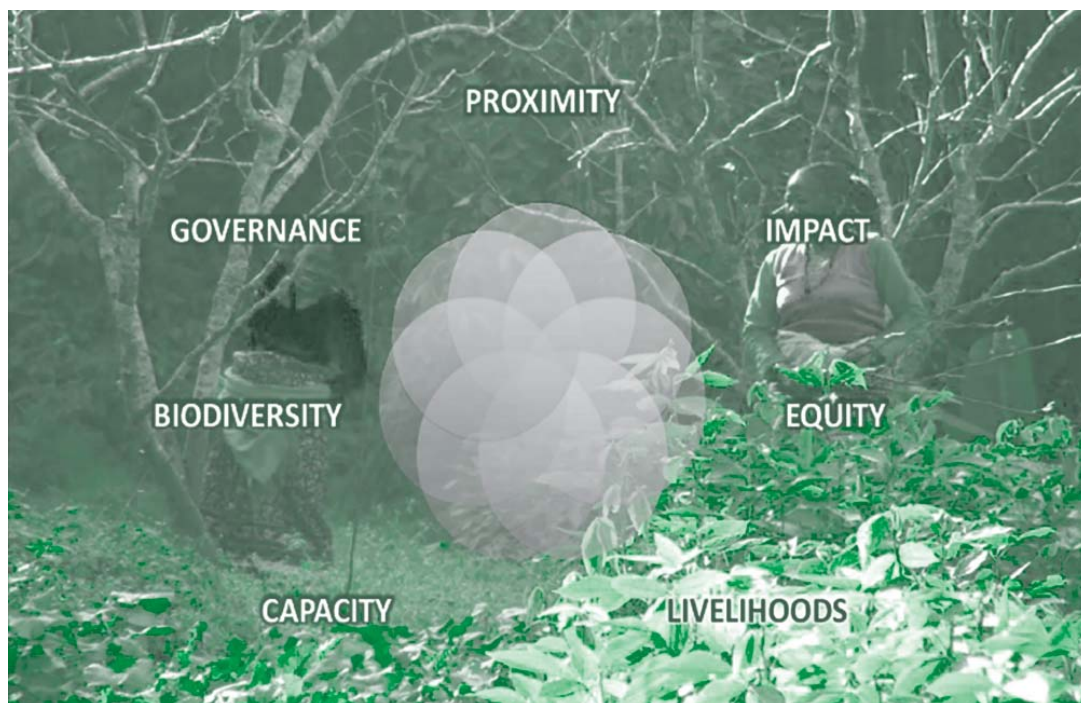


Figure 1: Interlinkages between biophysical and social dimensions in CF (Source: Malla, 1992)

2.0 EVOLUTION AND DEVELOPMENT OF COMMUNITY FORESTRY IN NEPAL

There is a long history of government's endeavour in protection and management of forests in Nepal (Tiwari, 1990). Many efforts have been made to combat against the deforestation and forest degradation problems. Prior to 1950s, the forests were used and managed by their *de facto* private owners (Joshi, 1993). Private Forest Nationalization Act, 1957 marked the beginning of the formal policy intervention for forest management, which came into light with a view to consolidate all scattered forest resources as national property. All the privately owned forests were seized back from the hands of feudalists, declared them as national asset, tried to check further depletion of forest patches and intended to optimise its use for the sake of people and nation. However, the government failed to communicate the message to the local communities (Joshi, 1993). It gradually led to the deforestation and destruction of vast tracts of valuable forestland. The government's subsequent policies to increase forest revenue, expand agriculture, implement resettlement programs and develop nation's infrastructures also contributed in the destruction of forests.

In this background, the Himalayan Environmental Degradation Theory was postulated in the beginning of the 1970s, predicting the environmental and socio-economic collapse of Himalayan region by 2000 AD (Eckholm, 1975). This created the pressure on the forest bureaucracy to revisit the forest management policy adopted by the Government. As a consequence, a conference of forest officers was organized in 1975 to discuss forest management issues and the concept of local participation was introduced, discussed and accepted. In 1976, The National Forestry Plan was formulated which formally recognized the role of people's participation in forest management and became a corner-stone for the ongoing successful community forestry programme in Nepal. Based on the recommendation made by this plan, the Forest Act, 1961 was amended in 1978 and the Panchayat Forest Rules (PFR) and Panchayat Protected Forest Rules (PPFR) were promulgated. In the meantime, the World Bank (1978) sensational report of entire depletion of the Nepalese forests within 15-25 years, due to the prevalent higher deforestation rate, drew international and national attention. This situation brought international donor agencies in the forestry sector development in Nepal.

Panchayat Forest and Panchayat Protected Forest Rules 1978 made community forestry a legitimate form of forestry intervention in the country and set regulatory framework for much of the community forestry activities during 1980s. The real efforts in the field went into developing and testing modalities for planning and implementing community forestry. A major breakthrough came with the recognition and documentation of the wide spread existence of indigenous forest management systems in

the middle hills. This provided much of the rationale for shifting the focus of community forestry responsibility and authority from the Panchayat administration/ political units to forest user groups (FUG). In spite of the considerable of resources during this period only a handful of FUGs had been formally established across the middle hills (Gilmour 2009).

Pressing global concern and recognition of the importance of forests, and country-specific "Tropical Forest Action Plans", the government in cooperation with donor agencies prepared and formally executed **Master Plan for Forestry Sector, 1989**. This plan laid down the foundation to handing over forests to groups of traditional forest users. It was widely recognized as a successful development initiative which focused on enhancing the local communities' participation in decision making and benefit sharing for the conservation and management of forest resources. It determined four long-term and 3 medium-term goals, prescribed six primary and additional six supportive programs and proposed **Community and Private Forestry** as a highly prioritized program. That facilitated the formulation of the progressive policies of - recognizing forest users as the managers of forests, entrusting them all rights and responsibilities to protect, manage and utilize all forest products and income; recognizing CFUGs as autonomous and self-governing institutions; and changing the roles of forestry staff to advisors and extensionist as, and retraining the entire staff of the MFSC for their new roles (Kanel and Acharya, 2008).

Although the first institutional shift occurred in 1978, a more progressive devolutionary shift took place through the promulgation of **Forest Act, 1993 and Forest Rules, 1995** which allowed forest-dependent local communities to directly participate in and take control of forest management at the local level. Nepal's Forest Act 1993 is considered to be one of the most progressive legislations of the contemporary world in terms of local people's rights on forest resources. These legislations clearly define the community Forest User Group (CFUG) and its status (as an autonomous, corporate and perpetual secession body), its formation and registration process, its responsibilities and functions, operational plan preparation and forest handing over (and resumption) process, role and responsibilities of DFO (facilitation, technical support, administrative and regulatory functions). It is, indeed, a radical change over the customary rights in the history of Nepal's forest development sector.

In 2000, Government revisited the MPFs and other former policies, identified gaps and formulated the **Forestry Sector Policy, 2000**. Particularly, it focused on management in Terai, Inner Terai, Chure regions; banned green trees cutting for five years, declared 40% tax on the outside sale of timber from CFUGs, recommended Chure region as protected forests. However, this governmental tax has been reduced to 15% in later years and limited to only few timber species and Terai/inner Terai regions of Nepal.

The Department of Forests prepared and executed **Community Forestry Development Guidelines, 1995** to

facilitate CFUGs, forestry technicians and facilitators to effectively implement the program. It is very useful field manual in the CFUG formation and its constitution and operational plan preparation process. It has subsequently revised in 2001, 2009 and 2014 to simplify the process and make it more inclusive, participatory and pro-poor. Representation of at least 50% women in executive committee and allocation of at least 35% of CFUG fund for poverty reduction programme were made through second amendment in 2009. Similarly, Community Forest Resource (CFR) Inventory Guidelines, 2000 (and its updated version 2004) has become very useful (to CFUGs and field-level technicians) to assess the forest condition, growing-stock, mean annual increment, density of forest and canopy, harvestable amount of forest products, biodiversity status and overall biophysical condition of the forest. These attributes are pre-requisites for technical management of forests.

The latest **Forest Policy, 2015** has given the stress on the appropriate silvicultural system-based community forestry management to enhance production and productivity of forest to increase financial capital which ultimately contributes to livelihood support and poverty reduction. It intends to shift community forestry from subsistence approach to commercial/market approach.

Community forestry has been developing through broader consultation among stakeholders in national and international fora. In this connection, since 1987, six national-level and one international-level community forestry workshops were organized, discussed and gave ways out in various emerging issues to build CF as the sustainable institution for better forest management, address climate change issues and rural development of Nepal.

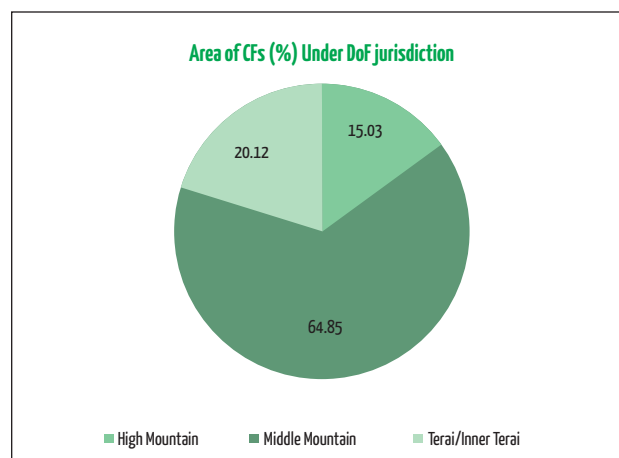
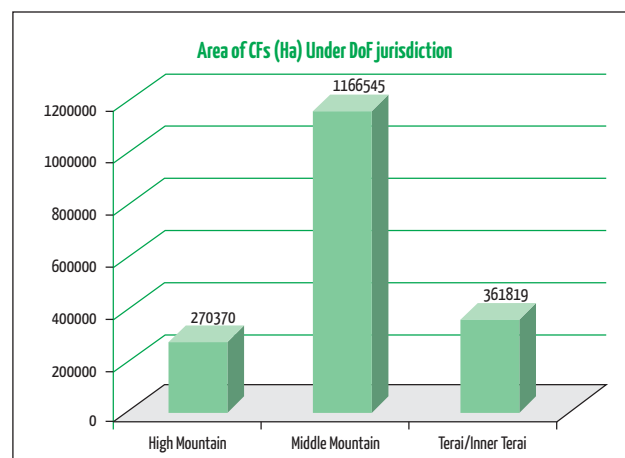
3.0 PRESENT STATUS OF COMMUNITY FORESTRY

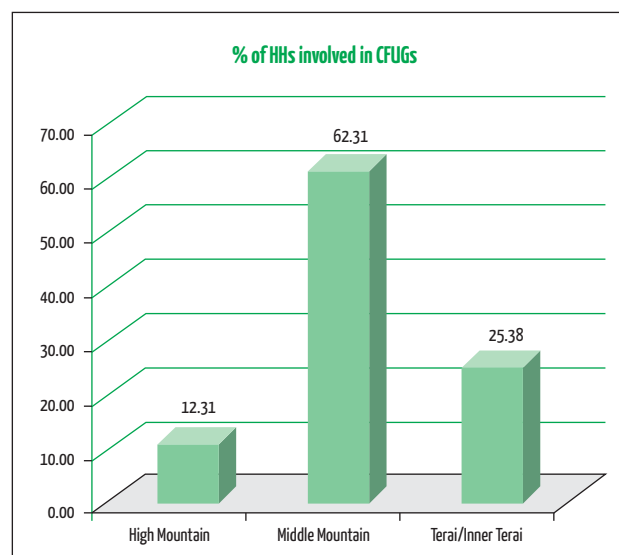
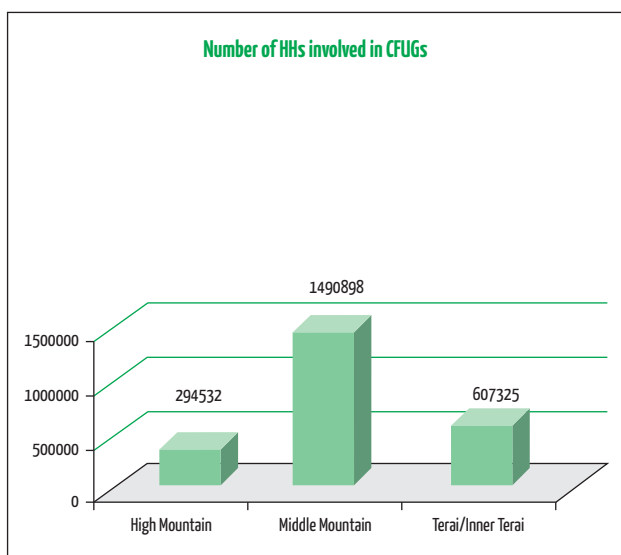
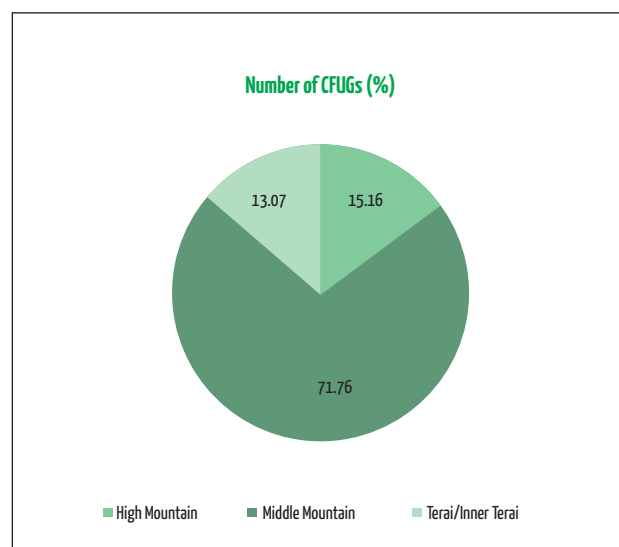
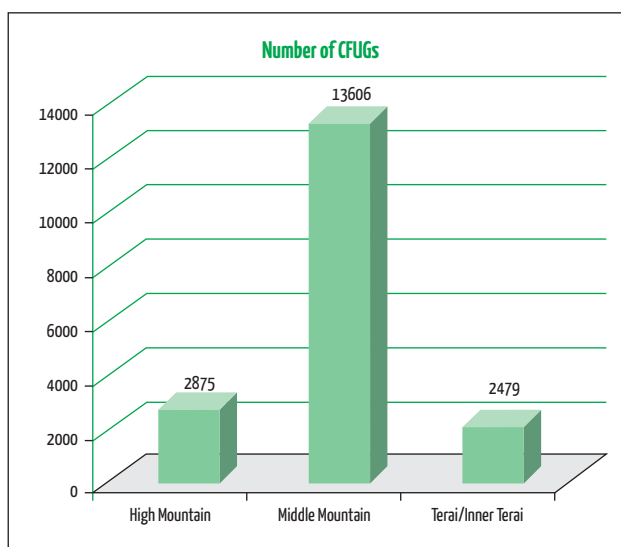
Until June, 2015 around 1.8 million ha. (31% of total national forest area) has been handed over as CFs under DoF jurisdiction. There are number of buffer-zone CFs under DNPWC jurisdiction too, however, we could not present the facts and figures in this paper. The statistical status and region-wise analysis of number of CFs, beneficiary HHs, area of handed-over CFs are presented in the tables and various graphs below: Among three ecological regions, the coverage of CFs is the highest in terms of number of CFUGs, area and HHs. Among the five development regions, the highest number of CF/UGs and HHs are in western development region but the highest area coverage is in mid-western development region.

A. GEOGRAPHICAL REGION-WISE CF/UG DATA ANALYSIS.

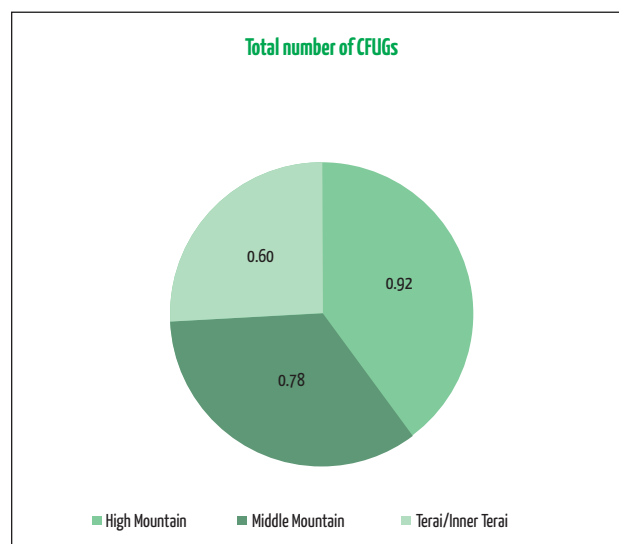
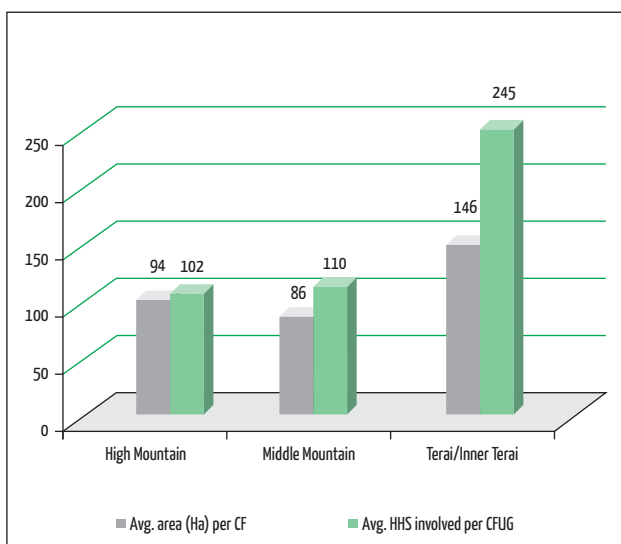
Geographical Regions	Number of CFUGs registered		Area of CFs (under the jurisdiction of DoF)		Number of HHs involved		Avg. area (Ha) per CF	Avg. HHs per CFUG
	Number	%	Area (Ha)	%	Number	%		
High Mountain	2875	15.16	270370	15.03	294532	12.31	94	102
Middle Mountain	13606	71.76	1166545	64.85	1490898	62.31	86	110
Terai/Inner Terai	2479	13.07	361819	20.12	607325	25.38	146	245
Grand Total	18960	100	1798734	100	2392755	100	95	126

NUMBER AND PROPORTION OF HHS INVOLVED IN CFUGS (ECOLOGICAL REGION-WISE)





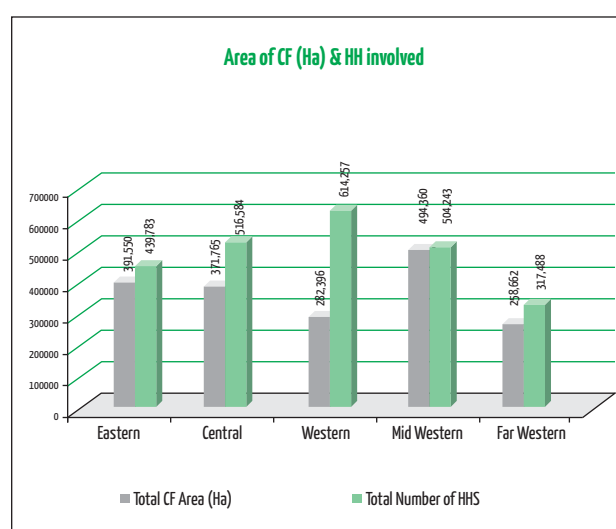
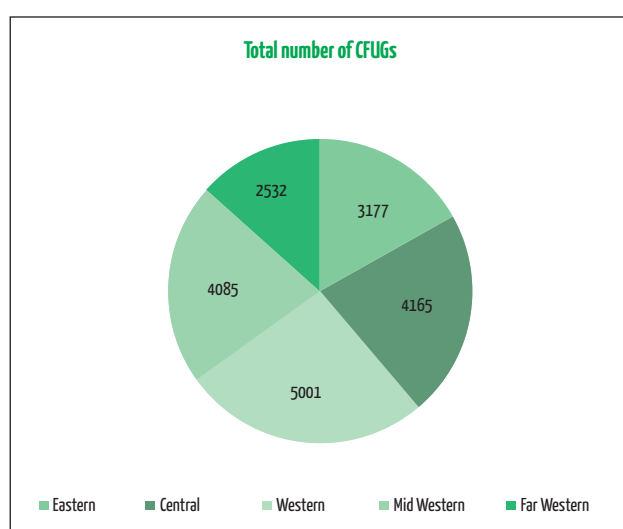
AVERAGE AREA (Ha)/CF, AVERAGE HHs/CFUG AND CF AREA/HH



B. DEVELOPMENT REGION-WISE CF/UG DATA ANALYSIS.

Development Regions	Total CFUGs		Total CF Area (Ha)		Total Number of HHs	
	Number	%	Number	%	Number	%
Eastern	3177	16.76	391,550	21.77	439,783	18.38
Central	4165	21.97	371,765	20.67	516,584	21.59
Western	5001	26.38	282,396	15.70	614,257	25.68
Mid Western	4085	21.55	494,360	27.48	504,243	21.08
Far Western	2532	13.35	258,662	14.38	317,488	13.27
Grand Total	18960	100	1,798,733	100	2,392,355	100

NUMBER OF CFUGS, AREA OF CF AND HHs INVOLVED IN CFUGS.



4.0 ACHIEVEMENTS AND CONTRIBUTION OF COMMUNITY FORESTRY IN NEPAL

Community forestry has brought a considerable amount of quantitative and qualitative positive changes in biophysical condition of forests as well as society. A brief description of the achievements and contribution of CF in various domains has given below:

4.1 Improving Biophysical Condition of Forest

Reversing the alarming state of deforestation and forest degradation is the greatest achievement of community forestry in Nepal. Bare, denuded and degraded forestlands

have regenerated and condition of forests has substantially improved. A number studies reveal that CF practices have brought visible positive change in the regeneration status, canopy density, stem density, biodiversity, basal area, forest cover and improved environmental condition (Branney and Yadav, 1998; Jackson *et al.*, 1998; Kandel, 2004; Pandit and Bevilacqua, 2011). A study carried out in eastern four hill districts showed that in 14 years' period (1994-2008) the overall (for all forest types) increase in stem density, biomass/carbon stock and basal area per hectare were found 29%, 21% and 25.3% respectively. However, the shrub count was found negative (decreased by 44.7%) because shrubland had been converted into productive forests (Yadav, 2014). An assessment of forest condition revealed that 74% of forest area managed by CFUGs was found in good condition (Ojha *et al.*, 2009). Similar study carried out by MFSC-Multistakeholder Forestry Program in 2012 has reported the overall improvements in forest condition since handover to CFUG (86% of CFUGs indicated improvement of forest condition).

The community forestry has significantly contributed in soil erosion control and watershed management. The increase in forest cover has led to the increased supply of environmental services by decreasing sedimentation, reducing the runoff and increased water flow to the Kulekhani reservoir (Upadhyaya, 2009). Community forests have also laid the foundation for biodiversity conservation by reversing the trend of deforestation and increasing regeneration (Shrestha et al., 2010). The consequence of forest condition improvement has enriched biodiversity. There are many instances that wildlife population is increasing and led to wildlife depredation problems among the farmers and surrounding residents. The species diversity and species richness index of different use types were found to be higher in CFs than those in NFs. Tree species and wildlife were found effectively increased while NTFPs found moderately increased within the CFs (Paudel, 2009). The conservation efforts made by the CFUGs have reduced forest fire incidences. Regulated grazing, controlled haphazard extraction of forest products, reduced soil erosion and improved watershed condition.

4.2 Institution Building and Governance Reform

The emergence and well-functioning of community forest user groups is a unique institutional innovation for decentralized forestry governance. This grass-root level, corporate, autonomous and self-governing entities are locally vibrant and robust. Devolved communities play the role of forest managers for the management of their forest resources through collective action. Forest governance has become more effective and efficient due to the partnership between the state forest agency and forest user groups. They adopt democratic process and practice under their approved constitutions. Well defined

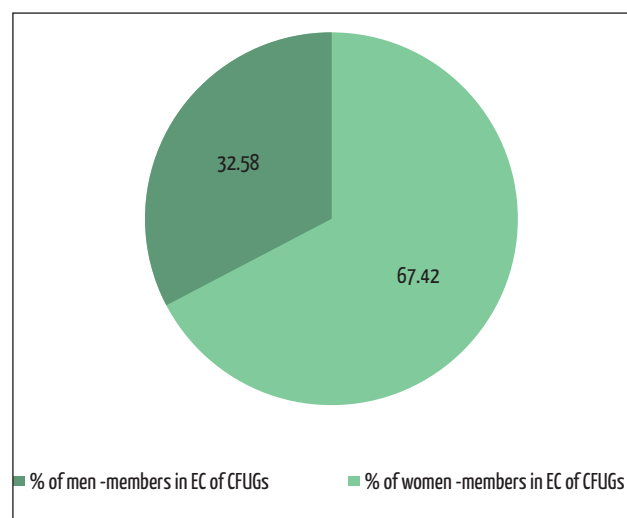
legal and institutional arrangements as well as tenure rights have been established. These are the key strengths which ensure the sustainability of CF management. Various government/NGOs/CBOs efforts significantly contributed in the development of the better institutions and governance conditions in CF.

4.3 Gender, Equity and Social Inclusion

Community forestry has brought women, poor and other marginalized communities in the decision-making process. Community forestry development guidelines, 2009 obliged the communities to include at least 50% women representation in decision-making position (in executive committee), 35% of the CFUG's fund must be spent in the activities related to poverty-reduction, women's empowerment and the capacity development of marginalized communities. Higher proportion of women in the decision maker position of CF proved significantly greater improvements in forest condition in both Nepal and India (Agrawal, 2009). Women leadership in CFUGs demonstrates promising results in terms of organizing and mobilizing women and marginalized communities to advocate their needs, concerns and rights, and to increase their access to and control over CF resources. The inclusion and empowerment process has also enhanced women's and marginalized communities' ownership and ensured the accountability of users' committees towards general users (Acharya and Gentle, 2006).

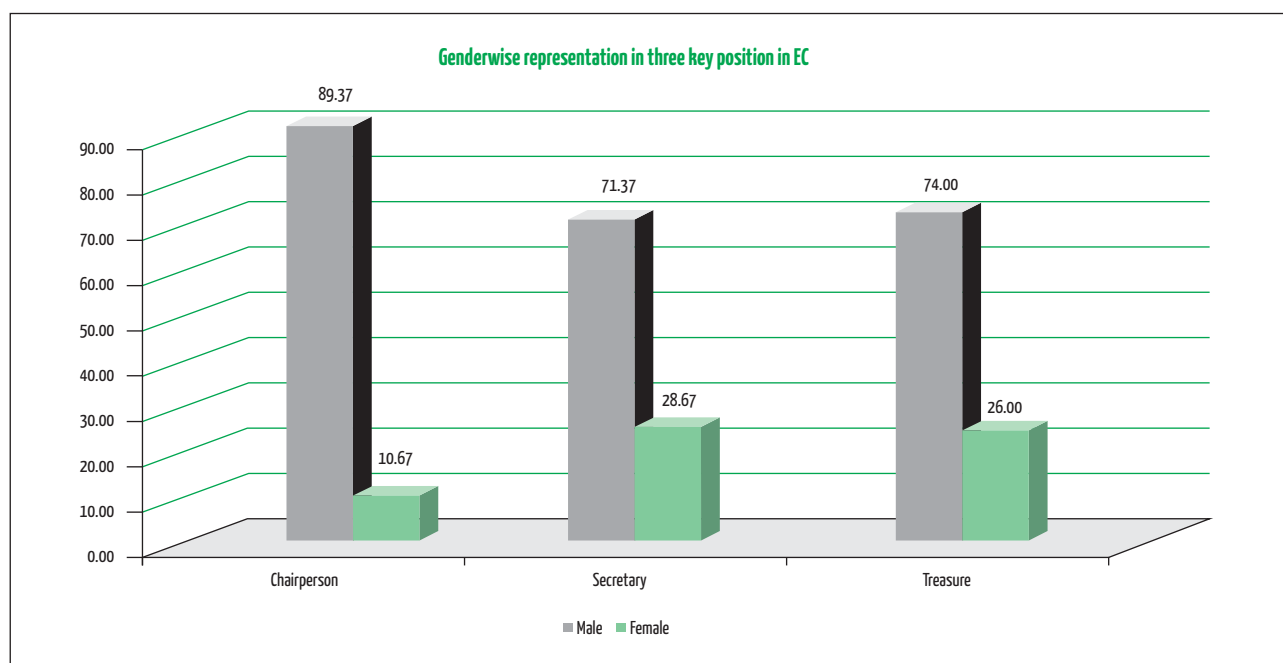
Despite legislative mandate, there is the under representation of women in executive committees. There are altogether 211,167 executive committees' members in total 18,960 CFUGs in the country in which 68,789 are women DoF-CFD, 2015). The proportion of men and women members in EC is presented as below:

PROPORTION OF MEN AND WOMEN IN EC OF CFUGs (NATIONAL AVERAGES)



A case study carried out by Sapkota *et al.*, (2014) in Ramechhap district on status and challenges for inclusion of women and disadvantaged section in community forestry also reveals the under-representation of women in the executive committees of CFUGs as below:

Although the threshold given by CFD guidelines has not met, the leadership development and inclusion of women and other marginalized communities in decision-making has been substantially increasing. A study carried out by FPR, Samarpur Program in 2005 (in six CFUGs of Bardia and Nawalparasi districts) shows that the percentage of women in key positions has increased by 65% in three years. The result seems to be similar in case of the representation from marginalized communities like Dalit and Janjatis. However, the representation of women is seen very close to and a bit higher compared to the constitution of Nepal. It can be perceived as a very good achievement.



4.4 Creation of Livelihood Assets, Livelihood Improvement and Poverty Reduction

Community forestry has significantly contributed to the improvement of forest condition and people's livelihoods in number of ways such as capital formation, governance reform, community empowerment and social change. Community forestry has become the means to increase natural, human, social, financial and to some extent the physical capital of CF users (Pokharel and Nurse, 2004).

Natural capital: Various evidences back up the positive changes in forest condition, increasing production and the availability of forest products and concurrently reducing the time spent for forest products' collection. Enhancing the production of forest products and marketing them generate the financial capital which ultimately supports livelihood of the communities.

Social capital: CF process has strengthened social cohesion through collective action, mutual trust, conflict resolution, ensuring participation in decision making, building networks, enhancing the access of poor, women, powerless and disadvantaged groups left in isolation and excluded from mainstream social and political processes.

Human capital: CF program has been conducting various capacity building activities (trainings, workshops, interactions and exposure visits) for users, EC members, facilitators, government employees, members of NGOs and CBOs, entrepreneurs, teachers etc. since its inception. This program has increased awareness, knowledge and skill related to silvicultural management of forest, NTFP cultivation, management, harvesting, processing and

value addition, community development, organizational management and leadership development, income generation etc.

Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods. Resource-rich FUGs have carried out and supported many social and community development activities. Construction of village trails/roads, small bridges, community buildings, rural electrification, schools and temples are the good examples of *physical capital* created through community forestry program.

Financial capital denotes the financial resources (stocks and flows) that people use to achieve their livelihood objectives. This includes income, savings, credits etc. The CFUG fund generated from the sale of forest products, levies and outside grants are the *financial capital* created through community forestry. A study shows that annual cost for the management of community forestry is about NRs. 119 thousand for each community forest user's group in the studied three districts. Similarly the annual monetary benefits (only direct) per Community Forest User Group (CFUG) per year is NRs. 710,000. This indicates that the benefits are about 7 times greater than the costs even without considering the indirect benefits. Of the total about 80 % benefit comes from the forest products, about 11 % from time saving and about 7 % from employment generation due to better management of community forestry. It is also found that CFUGs are able to mobilize about NRs. 38 million and utilizing part of it for the development of community in different ways (Bhattarai, 2011).

4.5 Employment Generation

Nepal's CF has huge potential of generating income, employment and government revenue through the utilization of timber and non-timber forest products. CFUGs carry out different operations for the protection, management, development, utilization of forest resources. In addition, they conduct various activities related to social and community development, livelihood support and poverty reduction, capacity building and social mobilization etc. and simultaneously a large number of local people get employment from these activities. A study related to timber harvesting and management shows that about 21,000 full time jobs are generated every year (Paudel *et al.*, 2014). We can assume similar figure of employment generation in forest protection and CFUGs' office management (forest watchers and office staffs). Other activities such as NTFPs collection and processing, silvicultural operations, scientific CF management activities, value addition process etc. create considerable amount of employment. Another study reveals that on average 640 person days employment are generated per CFUGs per year (MFSC-MSFP, 2013).

4.6 Forest Agricultural Interface Improved

There exists intricate relationship between forest and agriculture production and productivity. After the commencement of CF practice, livestock farming and crop production has increased. Rasaily (2006) concludes that poor households rely more on the community forests than the rich households for crop production and livestock rearing. A case study in 60 CFs in NSCFP districts (i.e. Dolakha, Ramechhap and Okhaldhunga) indicates the improvement in forest-agriculture interface following the establishment of community forests in the villages (NSCFP, 2003). The report indicates the increased in biomass in CFs resulting in increased off-take of litter and organic manure on farmland which inspired many farmers to cultivate more varieties of cash crops than before. Availability of more quantity of grass and fodder from CFs has encouraged the practice of stall-feeding which have reduced grazing pressure too. Community forestry has inevitably provided necessary production inputs to increase the agricultural yields.

5.0 OPPORTUNITIES AND CHALLENGES

5.1 Opportunities

There is strong potential for community forests to serve as the basis for improving the quality of life and the status of livelihoods in rural people (Thomas, 2008). The concept and practice of community forestry began to reverse the trend of deforestation and forestland degradation as well as to fulfill the subsistence needs of forest products. To a greater extent, CF has achieved those objectives.

CF has created ample of opportunities in different aspects. It possesses a huge potential of producing timber and non-timber forest products and environmental services. Applying appropriate silvicultural system-based production model, production of wood products can be optimized. Similarly, cultivating and managing non-timber forestry crops, huge quantity of NTFPs can be produced. In this way, demand and supply system of forest products can be regulated. This production approach drives and links CF into commercial market. In this connection, there exist a wide scope of establishing forest-based industries and enterprises which can produce value-added products and generate a significant number of employments as well. In fact, CF has created the space for private investors who can establish and run such industries and enterprises. The greater amount of financial capital formation and a significant number of employment generations directly contribute the poverty reduction and local people's livelihood.

In addition, CF has enhanced various environmental or ecosystem services which can be transformed into financial capital too. For example, by promoting eco-tourism, connecting with carbon markets and accounting of and paying for ecosystem services may generate income and employment.

There is a high scope for research and assessments in the field of community forestry. CFs can be taken as an Open University and data bank for participatory resource management. Researchers may carry out number of research and assessments on comprehensive impact study of CF, decentralized governance, institutions, policy and legislation, forest management, forest products/production and marketing, forest enterprise, NTFPs, GESI, biodiversity, PES, REDD+, socio-economic development, CF-agriculture interface and many more.

Undoubtedly, community forestry has rehabilitated the wildlife habitats along with the improvement of forest condition. Fragmentation of forest landscape shrinks the territory and inhibits the wildlife mobility. It increases the vulnerability of wildlife and human-wildlife conflict. From this perspective, there is a great scope of connecting community forests and adopting integrated conservation and management practices which may secure biological corridors and contribute biodiversity conservation.

Community forestry has established as a multi-stakeholder sharing process and platform. Inputs getting from the local, sub-national, national, regional and international workshops, interactions, dialogues and exposure visits, researches and assessments; the emerging issues, conflicts and ambiguities have been resolving. In many aspects, the CF provides a good opportunity to make better off inclusive governance in CFUGs, gender balance, equitable benefit sharing, institutional and individual capacity enhancement etc.

5.2 Challenges

Persistence of exclusion and inequitable distribution of benefits

Although community forestry is fairly successful at conservation, there remain huge wealth disparities between community forest member households, limited access to vital forest products, and significant power disparities within community forest user groups (Thomas, 2008). In one hand, poor households do not have the ability to pay for forest products and on the other hand they lack private alternatives. That is the reason why landless, poor and occupational communities are compelled to illegally get forest products they need from adjoining natural forests due to the closure of community forest in the name of protection. They rarely voice their arguments in their favor to extract products for meeting their requirements.

The elite supersedes the interest of the poor and marginalized section of the community. Therefore, the equitable distribution of benefits generated from the CF seems to be a big challenge. Making CF more responsive, accountable and transparent towards poor and marginalized group is daunting challenge.

Enhancing forest productivity and optimizing production

Except few examples, most of CFUGs in Nepal focus on protection and practice only 'passive' management, rather than active, production-oriented forest management. Protection of forest merely not enough, substantial financial capital formation by converting natural capital is the key issue. They lack understanding, expertise and capacity to adopt the silvicultural-based system of management which can sustainably produce optimum level of forest products without compromising the quality of forest.

Tapping intangible benefits

Besides the tangible forest products, community forests are supplying various types of environmental/ecosystem services. The emerging environmental services are biodiversity, carbon sequestration and hydrological services. In the absence of mechanism for payment, the communities are not paid for supplying the environmental services. Increasing benefits from environmental services could make forest users more responsible towards the conservation of forests (Agrawal, 2010). One of the prominent challenges of CF is to develop and institutionalize the mechanism of payment for environmental/ecosystem services which ascertains the communities to get such benefit.

State-restructuring and community forestry

Nepal is entering into the federal system of state-restructuring. How different layers' of governing systems perceive and recognize community forestry yet to be clear.

Whether central, state and local governments legitimize and ensure the rights of the local communities over the CF resources seem to be a big challenge at the moment.

Maintaining and sustaining good governance

The impact of the community forestry depends on the performance of governing institutions. Governance is always a key issue in CFUGs. So far, there are unexpected gaps in meaningful representation of poor, women and marginalized communities; transparency in mobilization of CFUGs' fund, accountability or responsiveness of ECs towards general users and equitable sharing of benefits. The challenge is how to maintain and sustain the good governance in community forestry.

Inadequacy in policy dialogue

Forest policy analysts have an opinion that we lack rigorous workout, comprehensive policy dialogue and in-depth policy analysis. As a consequence, abrupt policy change takes place. Sometimes, this creates a conflict among stakeholders. Declaration of Chure (Siwalik region) as a conservation area in 2014 has created such type of conflict and confusion among the stakeholders. There still exists *lack of mutual trust* among different stakeholders, transparency and long-term sustainability.

Coping with new emerging issues, i.e. climate change management, carbon-forestry and carbon trade, REDD+, payment for ecosystem services and biodiversity conservation.

Increasing politicization in user groups has resulted in further exclusion of those away from power centre (Hobbs, 2009). The challenge is how to ensure the rights of excluded groups?

Forest enterprise development, private sector involvement and investment security

Government frequently calls for the private sector involvement in the development of forest-based enterprises. In this connection, policy and legislation are also emerging. Unless the private sector invests in the forestry enterprises, value addition and employment generation cannot be achieved. There is a tremendous opportunity to invest in timber, non-timber and eco-tourism enterprises. However, the private sector is reluctant to invest in the forest-based industries and enterprises because of complex procedures, long-term business, unstable political scenario, fear of abrupt policy change and investment security. How to assure private sector in this field and secure their investment is a big challenge.

Environmental assessments

Above a certain threshold of area (500-750 ha. for IEE; over 750 for EIA) to be handed over to local communities and the revision process of their operational plan,

there is an obligatory legal provision to carry out initial environmental examination and environmental impact assessment. This is quite outrageous because various environmental supportive programs and activities (such as forest protection, plantation, forest fire control, grazing regulation, erosion control etc.) are carried out by the CFUGs. They are not allowed to carry out any activities which produce adverse environmental effects. This provision makes delay in handing over and operational plan revision processes, seeks for expertise and increases costs. Such provisions merely demotivate the local communities for their voluntary participation in CF management.

Implementation of legislations, guidelines, constitution and OP.

There are several provisions and conditions stated in Forest Act, Rules, Guidelines, Constitutions and Operational Plans of CFUGs yet to be implemented. Most of the users and even EC members are not aware of these provisions. The state of unawareness gives the elites an opportunity to take undue advantage either making decision in their favour or grasp the benefits coming from CF. The effective execution of all legal provisions to favor better forest management and livelihood enhancement of the poor is an important challenge.

Post-formation Support

The latest CF data update shows that there are around 19,000 CFUGs all over the country. The capacity of DoF, which is responsible to deliver the service to these CFUGs, is very limited. The demand of post-formation support is continuously increasing from the CFUGs. Without building their capacities and providing technical backstopping, the management of their CFs will not happen. After the devastating earthquake of the 2014, many CFUGs lost the infrastructures and institutional memories/records. Resource-poor CFUGs cannot invest for outsourcing too. To ensure the sustainable CF management, post-formation support is a must.

6.0 EMERGING ISSUES

Change dynamics always creates some new issues in every field of development. There are number of issues emerging in the field of community forestry. These issues need to be addressed to ensure the future of CF. Some key issues are pointed out below:

- Climate change management and REDD+
- Production-based CF (Silvicultural-based CF management)
- Linking CF to pro-poor program
- Private sector involvement in forestry enterprise
- Biodiversity conservation, **landscape** connectivity and human-wildlife conflict management.
- Payment for ecosystem services
- Governance reform.
- Future of CF in federal restructuring.

7.0 LEARNING FROM COMMUNITY FORESTRY

- Community-based local level institutions are more effective in forest resource management if the state ensures them rights over resources
- Systematic collective action can produce desired results in natural resource management
- Learning by doing is a guiding principle of CF development.
- The learning from particular geographical context could not be generalized and applicable as a blanket (blueprint) approach. If it is applied, it will not necessarily produce the expected result.
- Community forestry has to be shifted from the subsistence approach to commercial approach for prosperity.
- The involvement of and co-operation with the private sector is crucial to promote forest-based enterprises.
- Few impact assessments indicate that production and productivity of forests can be enhanced through the management practices of community forestry. It generates employment and supports local as well as national economy.
- Integrating natural resource management in landscape level, community forestry can contribute to biodiversity conservation and climate change adaptation.
- In local level, few CFs have practiced PES. For upscaling this practice, policy, legislation and institutional framework have to be formulated.
- CFUGs are concentrated more in forest protection and utilization. It should not be delayed to carry out silvicultural system-based CF management. To carry out effective silvicultural system-based CF management, it is better to cluster small CFs.
- To address the increased demand of ecotourism in CFs (which are proximate to urban areas and tourist destinations), policy, legal framework and guiding principles should be formulated.
- Strong network of CFUGs can play a vital role in CF development.
- CF is playing a mitigating and adapting role of climate change management.
- CF should be effectively linked to poverty reduction.
- Despite its success, there persists a problem in equity, inclusion and elite domination.
- Capacity enhancement and governance reform in CF is a must.
- Continuous post-formation support for CFUGs is prerequisite for better CF management.

8.0 CONCLUSION

CF is an institutional innovative approach in forest resource governance. As a response of the state-centre forest governance failure, this approach emerged in 1978 and its development was accelerated after the endorsement of MPFS, 1989 and promulgation of Forest Act, 1993 and Forest

Rules, 1995. It has been developing through the learning from the indigenous practices, model testing and wider stakeholder consultation and policy/legislation reform. So far, around 19 thousands CFUGs are managing around 1.8 million ha. Forests including over 2.3 million HHs directly involved and benefited. CF program has brought several positive impacts on forest condition, governance and institutions, socio-political dimension, economical and financial aspect and decentralized democratic practice. Further, CF has created ample opportunities in various aspects such as enterprise development, employment generation, timber and NTFP production, marketing and financial capital formation; climate change adaptation, nature-base tourism promotion, PES etc. However, it is not free from problems and challenges. Social inclusion, good governance, elite domination, equity etc. are some critical challenges. Some key issues (for example, future of CF in federal restructuring, climate change management, PES, silvicultural system-based CF management) are also emerging.

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Community Forestry for Biodiversity Conservation in Panchase Protection Forest Area

(A case study from Basulpakholjare CF, Syangja)

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Abstract

Panchase Protection Forest Area (PPFA) comprises of 17 VDCs from Kaski, Parbat and Syangja districts and is rich in floral and faunal biodiversity. Community Forests (CFs) circumscribed inside the PPFA contribute for overall ecological and environmental significance of the area. This paper explores how the different activities carried out by a Community Forest User Group in favor of floral and faunal diversity.

Basulpakholjare CFUG of Bangefadke VDC, Syangja was selected for the study. CFUG Constitution, Operational Plans and other relevant documents have been taken as the main sources of data. The findings show that both floral and faunal diversity inside the CF have increased. Active participation of CF users has resulted into: (i) increase in regeneration of forest species like Chilaune (*Schima wallichii*), Katus (*Castanopsis indica*), Tinju (*Diospyros malabarica*), etc. (ii) emergence of new species of plants like Chalne sisnu (*Gerardiana diversifolia*), Amala (*Phyllanthus emblica*), Utis (*Alnus nepalensis*), Lapsi (*Choerospondias axillaris*), etc. and restoration of forest, (iii) presence of many wild animals such as Leopard (*Panthera pardus*), Kalij (*Lophura leucomelanos*), Porcupine (*hystrix indicus*), etc. (iv) plantation of Bamboo, Nigalo (*Arundinaria species*) along the streams and steep slopes, and (v) awareness raising among CF members. Further comparison between the two Operational Plans (2005-2011 and 2011-2021) of the same CFUG shows that the priority has shifted from subsistence CF management to environment and biodiversity conservation. Issues and concerns of Climate Change have been integrated in the current OP. In addition to plantation inside CF, plantation in private land has also been emphasized in CC Adaptation Plan along with the management of invasive species. Plantation of Non-Wood Forest Products (NWFPs) and Medicinal and Aromatic Plants (MAPs) and skill development training have been given priority to support livelihood of member HHs for their long term participation in PPFA conservation. Use of Improved Cook Stoves, Bio-gas plant and solar panels installation are among the current priorities set by the CFUG.

Interaction with CFUG Committee members revealed that the awareness among the users is increasing towards conservation of Panchase area due to its importance on local environment and life support system. The major issues to be included are: (i) follow up and support to CFUG for implementation of revised OP, (ii) proper orientation to CFUG members on biodiversity registration, documentation and reporting, (iii) integration of biodiversity reporting in annual CF progress reporting and (iv) special package support for livelihoods, alternative energy promotion activities and wildlife damage.

Key words: Panchase Protection Forest, Community Forests, Biodiversity, Operational Plan

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1.0 BACKGROUND

Nepal's Community Forestry has been recognized globally as a successful model of managing forest resources in a participatory way. The Government of Nepal has considered the local people as vital partners for managing national forests, and they have been involved as local forest managers in different forms and modalities as per the existing legal and policy frameworks. Major community based forest management modalities include Community Forestry, Leasehold Forestry, Collaborative Forestry, Religious forestry, Protected Forestry and others. All these modalities are commonly known as Community based Forest Management (CbFM) modalities. These CbFMs evolved during 1970's when Panchayat Forest and Panchayat Protected Forests were started (Yadav *et al.*, 2014).

A part of national forest is handed over to local communities called Community Forest User Groups (CFUGs). District Forest Officer (DFO) is authorized to handover CF to CFUGs as provisioned in Forest Act, 1993 and Forest Regulation, 1995. As per the data of Department of Forests (DoF, 2015), a total of 1.7 million hectares of National forest have been handed over as community forests which include 18,960 Community Forestry User Groups (CFUGs) benefiting 2.34 million households (with some duplication because of membership of one HH in more than one CFUGs).

Biodiversity refers to all the living things on Earth and the ecological processes associated with them. It is often described in hierarchical terms including ecosystem diversity, species diversity and genetic diversity. The concept of biodiversity is linked primarily to the idea of biological variation, which still comprises a vast amount of knowledge and projected future value that is unknown to science at the moment (MoFSC, 2014).

The diverse climatic and topographic conditions have favored a maximum diversity of flora and fauna in Nepal. The country occupies about 0.1 % of the global area, but harbors 3.2 % and 1.1 % of the world's known flora and fauna respectively. This includes 5.2 % of the world's known mammals, 9.5% birds, 5.1 % gymnosperms, and 8.2 % bryophytes (MoFSC, 2014). The country is also rich in diversity of agricultural crops, their wild relatives and domestic animal species and varieties. A total of 284 flowering plants, 160 species of animals (including one species of mammal), one species of bird, and 14 species of herpeto-fauna are reportedly endemic to Nepal. The richness of endemic species increases steadily from low to high elevations. The high altitude rangelands are especially important from the perspective of endemism (MoFSC, 2014).

The Government of Nepal has declared 23.31% of its geographic area as protected areas to conserve floral and faunal diversity (DNPWC, 2015). Altogether there are 20 protected areas (10 national parks, 3 wildlife reserves,

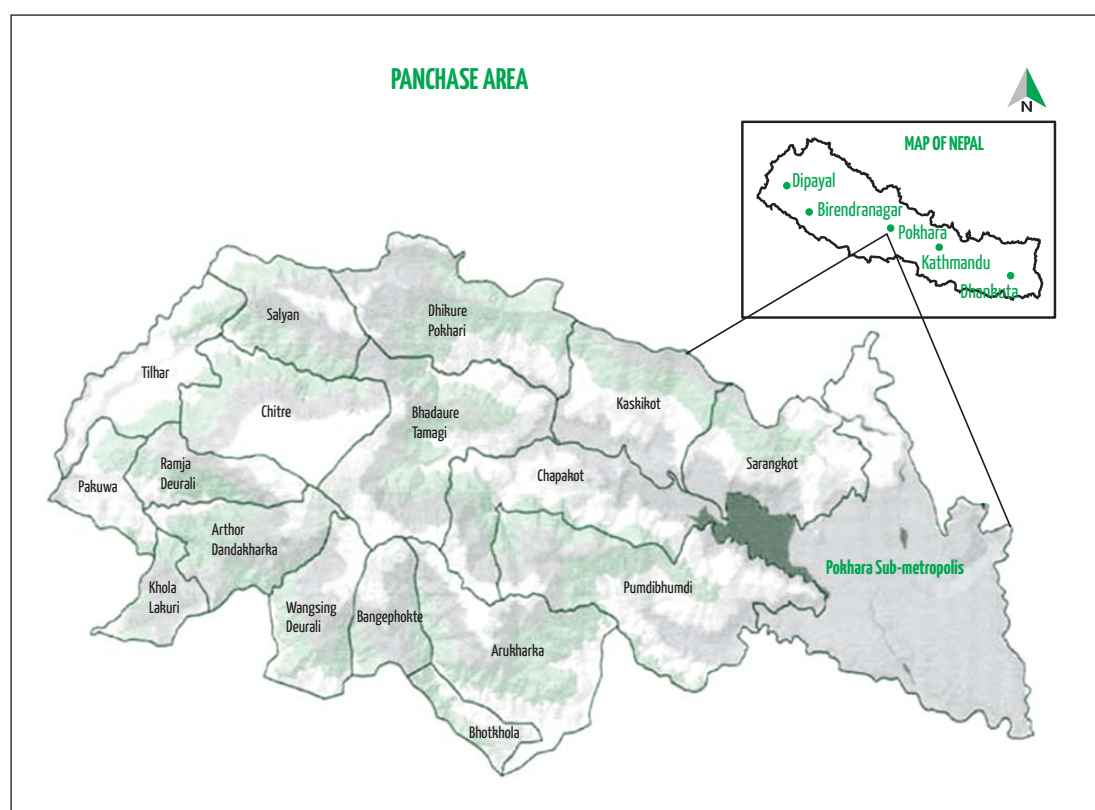


Figure 1: The geographical location of the panchase protection forest

6 conservation areas and 1 hunting reserve) across the country representing more than 80 out of the total 118 ecosystems. These are being managed by the Department of National Parks and Wildlife Conservation through its own institutional mechanism. Besides, there are buffer zones declared around 12 protected areas, which provide extra protection and address demand of forest products of the local people. The Buffer-zone forests are managed as conservation oriented Community Forests, which play crucial role for biodiversity conservation and ecotourism promotion.

The 5th CF workshop organized on 9-11 November 2008 A.D. concluded with a declaration which emphasized the importance of biodiversity in bundling environmental services from the forests towards institutionalizing the concept of Payment for Environmental services (PES) in a participatory mechanism (DoF, 2008).

Nepal Biodiversity Strategy and Action Plan (NBSAP) 2014-2020 has identified six thematic areas and fifteen cross-cutting themes (MoFSC, 2014). Community Forestry comes under the second theme i.e. forests outside the protected areas. Besides, cross-cutting themes like gender and social inclusion, climate change impacts and adaptation also belong to different aspects of community forestry.

Community Forestry, even initially conceptualized for mid-hills, is being implemented in Terai plains and mountain as well. The wide coverage of community forests across the country represents different ecosystems, which eventually support floral and faunal diversity.

Panchase Protected Forest Area (PPFA) comprises of 17 VDCs, with 15,964 HHs and 62,001 population, from Kaski, Parbat and Syangja districts. The elevation in Panchase area varies from 500m to 2,517m. The lowest elevation lies in the valley of *Seti* and *Modi* Rivers. The altitude rises from all direction to Panchase peak at 2,517m above the mean sea level. The Panchase area is composed of hills and valleys of different elevation. Forest ecosystem is the dominant type, covering 61 % of the land area. This is followed by agriculture ecosystem with 34 % and grassland ecosystem three percent. The area is rich in floral and faunal biodiversity. The area possesses 113 orchid species out of 400 species and over 400 birds. A total of 110 Community Forests (CFs) circumscribed inside the PPFA contribute for overall ecological and environmental significance of the area.

This paper has tried to explore the existing efforts and contribution made by a community forest for biodiversity conservation of Panchase Protected Forest Area (PPFA) and the future opportunities that can be expected from a community forest in overall national effort of biodiversity conservation.

2.0 OBJECTIVES

The main objective of the study is to explore how the different activities carried out by a Community Forest User

Group favor for floral and faunal diversity in Panchase area. The specific objectives are:

- To find out different activities of CFUG biodiversity conservation
- To compare key changes over period at strategic and operational level of CFUG
- To explore how a CFUG can contribute for biodiversity conservation of Panchase Protected Forest Area
- To explore key issues and concerns for forward actions

3.0 MATERIALS AND METHODS

Study Area

Basulpakholjare Community Forest User Group (CFUG) of Syangja district was selected for the study. The CF, handed over in 2051 B.S., lies in Bangephadke VDC ward no. 4. A total of 29.2 ha of CF area is being managed by 30 households (HHs).

Data Collection and analysis

Data were gathered from different sources. Observation of CF area and interaction with CFUG executive committee members were followed by review of Constitution, Operational Plans and different records maintained with them. Progress report and monitoring and evaluation report of DFO, Syangja and other reports and study findings were also consulted for the purpose. CFUG members' perception was also collected to respond the study objectives.

The data were analyzed mainly with descriptive measures aided by simple statistical tools such as mean, percentage, etc. CFUG's Operational Plans at different points of time (handover and OP revisions) were compared to find out distinct changes in floral and faunal diversity over the period.

4.0 RESULTS AND DISCUSSION

Institutional aspect of CFUG and Users' participation

Basulpakholjare CFUG comprises of 30 HHs. Out of the 30 HHs, there are only 2 HHs from Dalit and 4 HH from janajati, rest of the HHs are from so-called upper castes - Bahun, Chhetri and others. This forest was under shifting cultivation by the local people until they felt need to conserve the forest for their own benefits. They decided to stop further shifting cultivation and open grazing practices towards protection of the forests in early 80s. In late 80s they started protecting forests by themselves

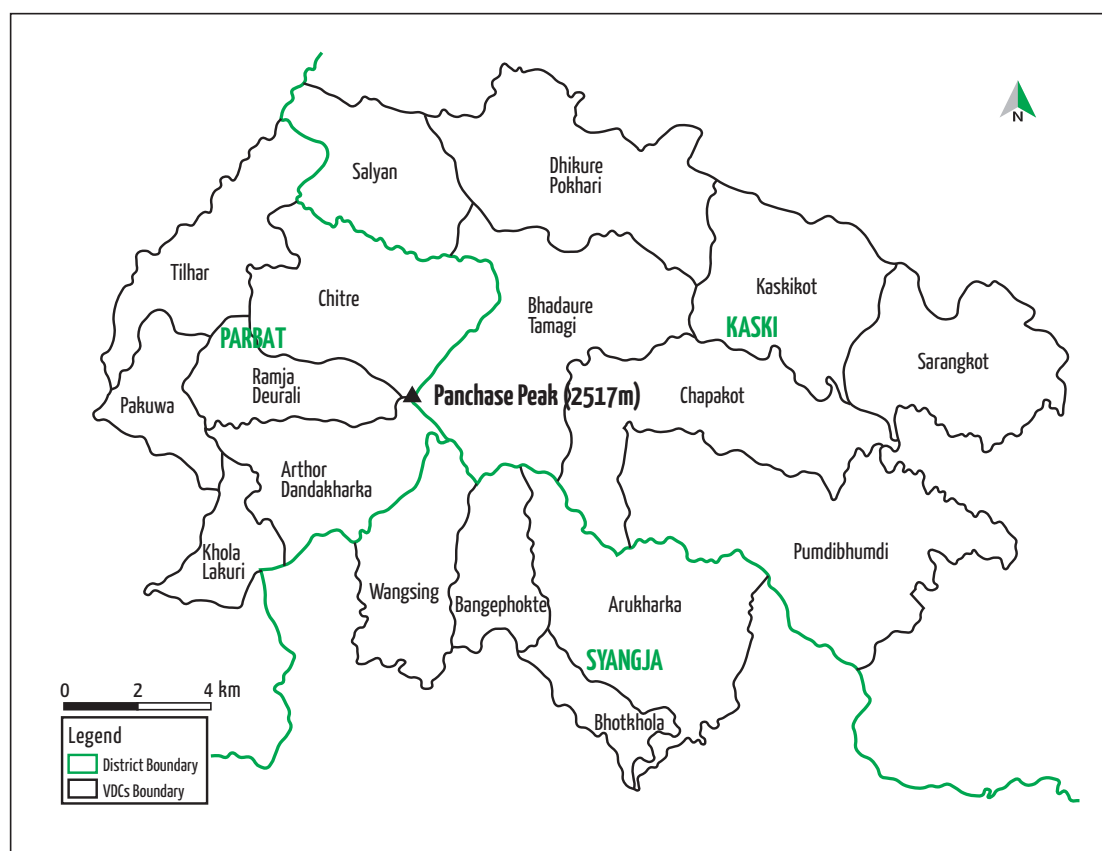


Figure 2: Geographical boundary of Panchase protection forest.

on daily turn by turn basis. On the basis of their interest and demand, the District Forest Office handed over the forest as CF to them on 2051/03/31 B.S. (1994). The OP of CFUG was revised in 2005 and 2011 in technical support and guidance from Range Post. CFUG members are active in conducting monthly meetings, participating in annual general Meetings (AGM) and need based meetings. The data shows that they have conducted 67% of monthly meetings (40 out of 60 planned during last OP period), 70% of AGM and have conducted 3 need based AGMs. The general members i.e. CF users are actively participating in revising the operational plans.

CFUG members have their own saving and credit scheme and the saved amount (NRs. 64,000) is mobilized within the group as easy loan at 20% interest rate. They organize mass meeting two times in a year (Chaitra 3 and Ashoj 3) mainly to manage the loan i.e., to collect the interest and payment of the loan invested. They have developed their own indigenous system of forest products distribution among the users – one gets firewood equal to 12-hath (1 hath equals to 18 inch) long *nigalo*-rope bundle at the rate of NRs 50. For timber, one household is provided with a tree at the rate of NRs 105, based on the consensus decision made by the committee members. The users are well satisfied with the system of forest products distribution. Recently, they have formulated anti-poaching unit and are

actively involved in regular patrolling of the forest which is supported by the PPFA.

Community Forest Management and Change in Floral Diversity

Basulpakholjare Community Forest was handed over to the community in 2051 B.S. (1994 A.D.). The CFUG members have been managing the forest by implementing the activities prescribed in the OP. The review made in the revised OP reveals that the users were not so active in implementing the OP in the beginning i.e. after hand over. This was due to the fact that the CFUG members were not so much oriented on technical aspects of the prescription. Later on after orientation and proper facilitation from the District Forest Office, Range Post Office, the users have become active and responsive to implement the activities prescribed in their OPs. Silvicultural activities, combining with the district DFO and NGOs staffs' knowledge, have been initiated by CFUGs according to forest condition and community needs (Dhital *et al.*, 1998 cited by Shrestha *et al.*, 2010).

A total of 29.2 ha of CF area is being managed by dividing into five blocks; the block area ranges from 5.2 ha to 7.63 ha. Each of the five blocks is dominated by Katus (*Castanopsis*

indica) and Chilaune (*Schima wallichii*) associated with a number of species such as Tinju (*Diospyros malabarica*), Mauwa (*Engelhardtia spicata*), Rakchan, Khalluk, etc. The data shows that the density of regeneration i.e. seedlings has increased on average in the blocks from 4400/ha in 2005 to 5660/ha in 2011. This finding is in line with the finding by Jha and Acharya (2008) that CF brought positive change in species diversity in CF. Over the time, the emergence of new species has also been observed by the local people, eg, some species like Chalnesisnu (*Gerardiana diversifolia*), Amala (*Phyllanthus emblica*), Utis (*Alnus nepalensis*), Lapsi (*Choerospondias axillaris*), etc. have been observed now but were absent in the beginning. Now-wood forest products (NWFPs) species have also been introduced/planted inside the CF.

Conservation and protection aspects of CF have also been considered by CFUGs with priority. Grazing has been banned inside the CF. In order to control soil erosion and landslides inside the CF, they have planted Bamboo, Nigalo (*Arundinaria species*) along the streams and steep slopes. They have shifted the CF management from subsistence to environment and biodiversity conservation oriented management over the period of last two OPs (2005-2011 and 2012-2021) by lowering the annual allowable harvest by 20% (prescribed AAC changed from 60% to 40% of Annual increment in the second renewed OP) (Table 1). The lowering of AAC by 20% has on an average decreased the quantity of timber harvest by 31.53% and fuelwood by 87% as compared to the previous OP, but this quantity is still sufficient to fulfill the users' demand.

Faunal Diversity and other environmental services

Improved CF management has resulted into favorable habitats for many wild animals. The major wild fauna observed in the CF are: Leopard (*Panthera pardus*), Kalij

(*Lophura leucomelanos*), Porcupine (*Hystrix indicus*), etc. Other fauna seen, some frequently and some occasionally, include: Kharayo, Syal, Titra, Monkey, Ban Kukhura, Kokle, Dhikur, Luinche, Ban Biral, etc. These animals were not seen inside the CF before the handover. Moreover, the event of wildlife sightings has increased as has been reported by the users.

Moreover, CFUG members are getting other environmental services as well. The interaction with CFUG committee members and few general members revealed that the water sources at few places have got restored after the area been protected and managed by CFUG members. The people of Setidovan (downstream) area are getting benefit of the water spring coming out of the forest at no cost. In addition, local environment has become healthier, cleaner and pollution free.

Initiatives to address Climate Change Issue

Panchase Protected Forest Programme (PPFP) has been supporting the CFUGs constituting the PPFA. The CF OP revised in 2011 has given more emphasis on addressing the climate change issues by incorporating different activities for adaptation initiatives. These include production of seedlings and plantation in open areas, promotion of conservation oriented sustainable forest management practices by implementing OP prescriptions, control of forest fire, anti-poaching activities, practice of agro-forestry in private land as well.

Use of alternative energy sources: Improved Cook Stoves (ICS), Bio-gas and solar panel installation have been prioritized for near future. Besides, hygiene and sanitation initiatives e.g. toilet construction and use by each HH, use of compost/vermi-compost manure are among their priorities. Some water resource management initiatives: protection of natural source of water by planting

TABLE 1: BLOCK-WISE COMPARISON BETWEEN THE PRESCRIBED AAC IN THE OP OF TWO PERIODS

Block	AAC in 1st renewed OP (2005 – 2011)		AAC in 2nd renewed OP (2012 – 2021)		% Change in AAC of timber
	Timber (cu.ft)	Fuelwood (bhari*)	Timber (cu.ft)	Fuelwood (bhari)	
1	88.90	217.14	56	33	-37
2	141.83	434.83	120	48	-15.39
3	243.09	576.91	117	47	-51.86
4	195.47	416	125.4	52	-35.84
5	129.83	71.39	107	42	-17.58
Total	798.41	1716.27	400	222	-31.53 average

*1 bhari = a bundle of about 30 Kg.

Alnus, bamboo, etc., water harvesting, construction of conservation pond have also been planned by the CUFG.

Improvement in livelihood of CFUG members is one of the main objectives of community forestry and PPFA project. The recent plan of CFUG also includes developing skills of the members on income generating activities and business including plantation of NWFP species inside the CF and their private lands.

Awareness on Biodiversity Conservation

PPFA project is being implemented in the area and Basulpakholjare CFUG is also part of the project. Due to different activities, trainings and orientation program delivered by the project (PPFP, 2014) as well as regular orientation and facilitation from DFO, Ilaka Forest Office, the level of awareness has increased in users. During the consultation, the members shared that they are very much aware of the fact that the existence of human beings is completely associated with the existence of biodiversity and environment. Further, they actively take part in AGM, monthly meetings and other meetings and discussions held with purpose of promoting community forestry. They have proactively included the different initiatives of biodiversity conservation and environmental aspects in the latest OP. In practice too, they inform the DFO and the Panchase staff members when they need the help to rescue wildlife, mostly problematic. In recent days, sometimes, they face the problem of wildlife damage to their cattle, and crop, so this needs careful attention in near future.

5.0 CONCLUSION

Based on the findings, this paper concludes that CFUGs of Nepal are significantly potential to contribute in biodiversity conservation. The following are the concluding points of the study:

- Both floral and faunal diversity inside the CF increased based on qualitative assessment and annual extraction has also been decreased as found through quantitative assessment of annual allowable cuts over the period.
- Level of awareness among the users increased resulting into local level initiatives for the conservation of the forest and biodiversity.
- CFUG- OP has been oriented towards biodiversity conservation.
- Proper funding support and guidance limit implementation of OP activities.
- Livelihood improvement initiatives motivate users in active participation.

6.0 RECOMMENDATIONS

- Follow up and support need to be provided for implementation of revised OP.
- Proper orientation to CFUG members on biodiversity

registration, documentation and reporting would result into better contribution from the CF.

- Proper guidance from DFO and/or PPFA project would be fruitful for integration of biodiversity reporting in annual CF progress reporting.
- Special package support for livelihoods, alternative energy promotion activities, wildlife damage should be planned and implemented.

7.0 ACKNOWLEDGEMENTS

We would like to acknowledge the organizing committee of the national workshop on Biodiversity and Community Forestry for providing us this opportunity of presenting the study findings for contributing overall national goal of biodiversity conservation through Community Forestry in Nepal. We are thankful to the members of Basulpakholjare CFUG, Syangja for providing data and information for this study. We are also thankful to the officials of Panchase Protection Forest Area project for their support and information to conduct this study.

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Impacts of Community Forestry in the Rural Development of Nepal

Damodar Sharma

Abstract

Regarding the promotion of rural livelihood in least development country like Nepal, Community Forestry (CF) has been playing vital role through providing social and economic capital (toward Socio-Economic Development and Food Security) to rural areas. The forest revenue generated from CF has been utilized in the various development activities of the community. The main underlying argument to support community forestry and development linkage is that the present rural development process in Nepal is being enhanced through the group approach. Seeing the success of CF, other sectors also has started to implement development activities through groups in a participatory approach to achieve desirable situation. The stability of social assets is not well defined but it is important for the strengthening and development of the Community Forestry in rural area of Nepal.

Community development as tools of rural development in the context of community forestry in Nepal; the present forest policy, rules and regulations provide the legal rights of the local people to manage the community forest for their priority needs. The surplus income of users group could be used for local development activities other than forestry. Community Forestry Users Group can also raise funds from different sources as indicated in the Act. It is also empowered to acquire use, sell, transfer, or otherwise dispose of mobile or immovable property by law. Although the basic objective of the community forestry programme is to fulfill the subsistence of forest products to the surrounding people, the new policy allows Community Forestry Users Group to cultivate non wood forest products including medicinal and aromatic plants, and any other perennial cash crops as well as the commercialization of community forestry products and their processing.

Liz Wily argues that community forestry is playing the role of an agent of social change in many ways. The 'success' of the institution in the form of the Community Forestry Users Group is more than socially inclusive forest management. It involves how the organization is already commonly used as a stepping stone to other self-determined and self-reliant developments, clean drinking water, resting place, road/path reconstruction, community/school building and provision of seed money for income generation activities.

Key words: Community Forestry, Livelihood, Sustainable Management

1.0 BACKGROUND

Nepal is considered as the pioneer of the community forestry programme. Once completely destroyed forest areas and naked mountains, have been restored with the successful implementation of the community forestry programme. Various studies reported that the greenery of the forests have been restored. The biodiversity has been conserved and it has further played significant role in the improvement of rural livelihoods. Besides, many of the authors and development workers highlighted the role of community forestry in the overall development of the rural areas in Nepal. However, the contribution of CF in rural development is less studied aspects in Nepal. Therefore, it is endeavored to study the CF contribution in rural development of the country. As the country is predominantly comprised of the rural areas, the CF has not only contributed in the rural development but also for the economic and environmental development of the nation.

The community forestry programme has already crossed the 40 years of its implementation at various forms. Till date, a total of 18,960 CFUGs including over 2.2 million households have been managing 1.798 million hectare of the national forests as community forests (DoF, 2015; unpublished). It has been the largest organization and development endeavor involving over 50% of the citizens of Nepal. It is found most successful in the midhills of Nepal where the fragmented patches of the forests and proximate settlements are found. There are few challenges emerged in the lowland Terai. The detail description of the CF evolution in Nepal is depicted in figure 1.

CFUG capacity building process

Capacity can be defined as the skills and knowledge about resources needed to perform a function. The generic meaning of capacity development is the process by which individuals, groups and organizations, institutions and countries develop their abilities, individually and collectively, to perform functions to solve problems and achieve objectives. Capacity building differs from capacity development in that the latter builds on a pre-existing base (UNDP glossary of key term 1998). The aim of capacity development and capacity building is to help governments, organizations and people attain a level of self-sufficiency that enables them to effectively manage their own affairs.

Internal management strengthening

Strengthening people's capacity to determine their own values and priorities, and to organize themselves to act on these, is the basis of development (Eade and Williams, 1995, cited by Eade, 1997). A capacity building approach involves identifying the constraints that FUG members experience in realising their basic rights, and finding appropriate vehicles through which to strengthen their abilities to overcome the causes of their exclusion and suffering. According to Lusthaus *et al.*, (1995), institutional capacity entails six main interrelated areas that underlie an institution's performance: strategic leadership, human resources, others core resources, programme management, process management and inter-institutional linkages. The capacity of the FUG can be defined as the creation of an idea and performance of a certain decision to accomplish

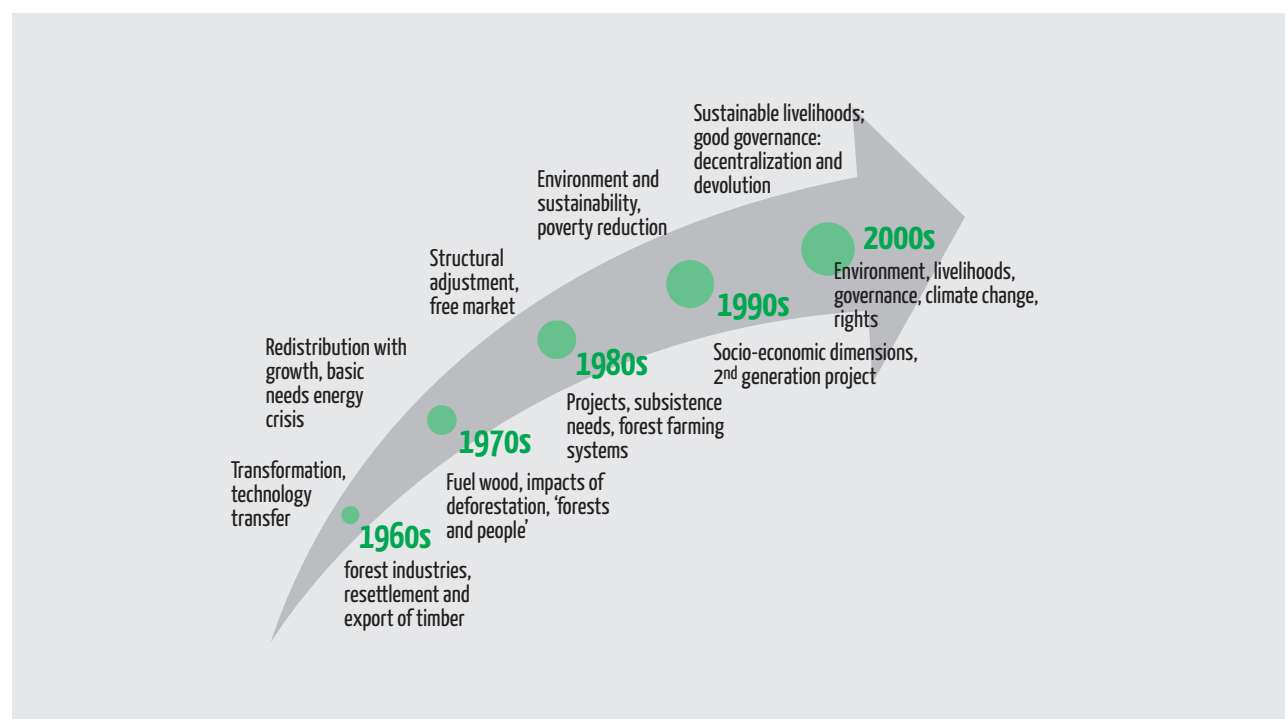


Figure 1: Evolution of the community forestry programme in Nepal (adapted from Malla, 2009)

a specific task within the institution. In the context of CF, capacity broadly relates to the ability for managing community, forest and financial resources effectively.

FUGs are generating both kinds (forest products) and cash as income through effective forest management. Forest products are mainly used for domestic purposes and communal construction works but surplus products are used commercially. Community development through CF is a new emerging concept in the rural areas of Nepal where forest users are involved in increasing communal facilities. The impact of the FUG can go further than forestry management, as many of the more effective and established FUGs start to become involved in other activities such as schools, water supply and trail maintenance (Dev *et al.*, 2003). Income generated from CF is invested for FUG institutional development, forest development, and community development. The need for development is the prime concern of people where they want to get every facility that they require but this is not sufficient to address the requirements of the entire community. The need of development in the community is realized by the FUG for addressing the scarcity of physical facilities. In a wider context, community development is explored and linked with the practices adapted by each FUG in Nepal. In this chapter, the concept, model and strategy for community development are discussed. In the context of Nepal, how FUGs are involved in community development initiatives, economic development and management of their funds is also explored. Analyses of FUGs' fund investment for different development activities, the fund management process and the prioritization of community development activities at FUG level are all contained in this chapter. In the final section, the potential of community development through CF is also explored based on the researcher's field observations and experiences.

2.0 OBJECTIVES

The main objective is to assess the Community Forestry Programme in rural development in Nepal and the specific objectives of the study are:

- Identify and analyze the impact of CF in the rural development activities of Nepal.
- Examine the needs and priorities of CFUGs in community forestry with the linkages between mode of production, mode of social regulation, and mode of CF fund utilization of accumulation for a community forest management.
- Identify the trend of contribution made by community forest toward the rural development in Nepal; and
- Suggest strategies to contribute by community forest in rural development of Nepal.

3.0 MATERIALS AND METHODS

This research is a mix of multi-theoretical approaches to address the research objectives. It therefore greatly employed a synergy of methodologies built-in partly explanatory and partly inferential approaches, which require a variety of reliable and accurate data from different sources using different methods for information collection. The selection of appropriate research methods is a most important part of any research. Therefore, both qualitative and quantitative methods were used in this research. The design mainly requires socio- economic, institutional and biological data, which were used to meet the objective of this research. The framework of research methodology is shown in Figures 2 and 3 as:

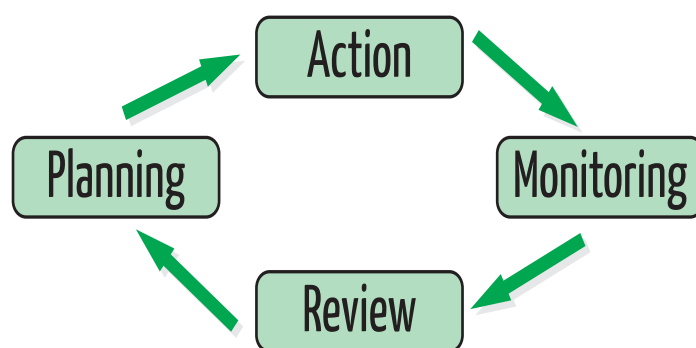


Figure 2: Methods implemented for the study

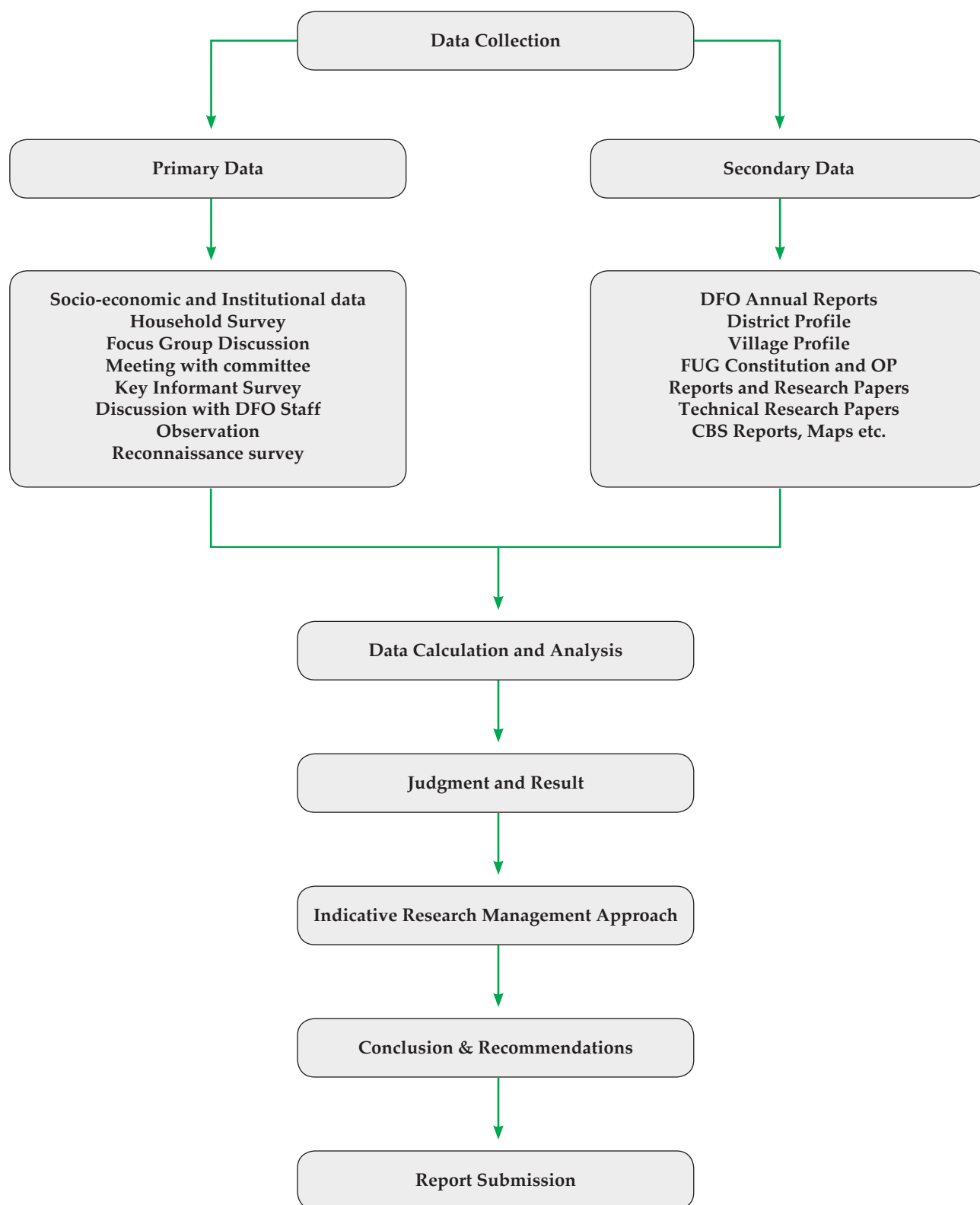


Figure 3: Frame work for research methodology

4.0 FINDINGS

The study found out various aspects of the community forestry in the rural development of Nepal. The study significantly details about the CF contribution in the overall development of the society. It has contributed in the promotion of the social assets (financial, institutional, human resources etc.). The CF has been perceived by all community members as the vehicle for rural developments.

TABLE 1: DESCRIPTION OF THE STUDIED COMMUNITY FORESTS IN 3 DISTRICTS OF NEPAL

District	Name of Community Forest	Status in the district	Area hectare	HH number	Address (Location)	Hand-over Date
Rupandehi	Charpala CF	Largest forest area	1621.5	7070	Butwal - 14	054/02/30
	Swablamban CF	Smallest forest area	0.78	36	Motipur - 9	057/02/29
	Charpala CF	Biggest user size (HHs)	1621.5	7070	Butwal - 14	054/02/30
	Rachana CF	Smallest user size (HHs)	01.5	18	Padkhauli - 1	059/01/03
Palpa	Khulkhule CF	Largest forest area	590.0	83	Dobhan - 4	059/12/15
	Aghillipipal CF	Smallest forest area	01.0	51	Telgha - 5	059/03/24
	Kuber CF	Biggest user size (HHs)	81.8	486	Yamgha - 3	062/07/11
	Jhirubash CF	Smallest user size (HHs)	22.0	12	Jhirubash - 3	060/07/05
Parbat	Khaharesalyan CF	Largest forest area	362.0	580	Barra chaur	2058/059
	Ganhale CF	Smallest forest area	0.4	39	Thapathana-3	2050/051
	Hampal CF	Biggest user size (HHs)	324	989	Salija / Lekhfat	2051/052
	Chiplesti CF	Smallest user size (HHs)	0.75	14	Khurkot-5	2055/056

TABLE 2: DETAIL DESCRIPTIONS OF THE STUDIED COMMUNITY FORESTS

District	Status of CF	Area hectare	HH number	Name of Community Forest
Rupandehi	Largest forest area	1621.5	7070	Charpala
	Smallest forest area	0.78	36	Swablamban
	Biggest user size (HHs)	1621.5	7070	Charpala
	Smallest user size (HHs)	1.5	18	Rachana
Palpa	Largest forest area	590.0	83	Khulkhule
	Smallest forest area	1.00	51	Aghillipipal
	Biggest user size (HHs)	81.8	486	Kuber
	Smallest user size (HHs)	22.0	12	Jhirubash
Parbat	Largest forest area	362.0	580	Khaharesalyan
	Smallest forest area	0.4	39	Ganhale
	Biggest user size (HHs)	324	989	Hampal
	Smallest user size (HHs)	0.75	14	Chiplesti

As per the set of criteria for study, the above mentioned 12 CFs were selected. The original idea of inventory data compilation was by species, diameter class and block. Although this data was computed, analysis of all these variables became very vague and it was decided to undertake analysis on the basis of the main forest type and block situation relating to main tree species, other tree species and other shrubs. Regeneration status, growing stock, annual increment, and proposed harvest level were calculated for whole forests because areas of blocks were not available or known to the user or the DFO. The combination of different research methods gave users insights with which to assess their own community forestry. This level of flexibility in the research design allowed the collection of relevant socio-economic and technical data of good quality as well as a good level of awareness and perception by users.

The contribution of the Community Forestry (CF) programme in the rural development of Nepal is described in the figure 4. The CF has provided various goods and services which are very essential to fulfill the basic needs of the society and their development at larger scale.

The CF has supported in the social, infrastructure,

institutional and environmental development of the society. Further, its contribution in mobilizing the saving-credit activities is also very important. The detail contribution is shown in table 3.

5.0 CONCLUSION

Community forestry has often perceived primarily as a strategy to have differentiation by maintaining or increasing forest cover rather than as a strategy to meet the need for products. The initial objective of community forestry was both conserving forests and providing direct and indirect benefits for communities that would support rural development. The vision of community forestry is the sustainable management of community forest through participation of users and the supply of desirable forest products. A part of national forest has been handed over to the FUGs as community forest but exclusion in terms of benefit sharing may be an obstacle to institutional development. Institutional development of the FUGs denotes positive change in developing capacity for the management of resources. For this, the FUGs require transparency and must generate the feelings of ownership and commitment by users within each FUG institution.

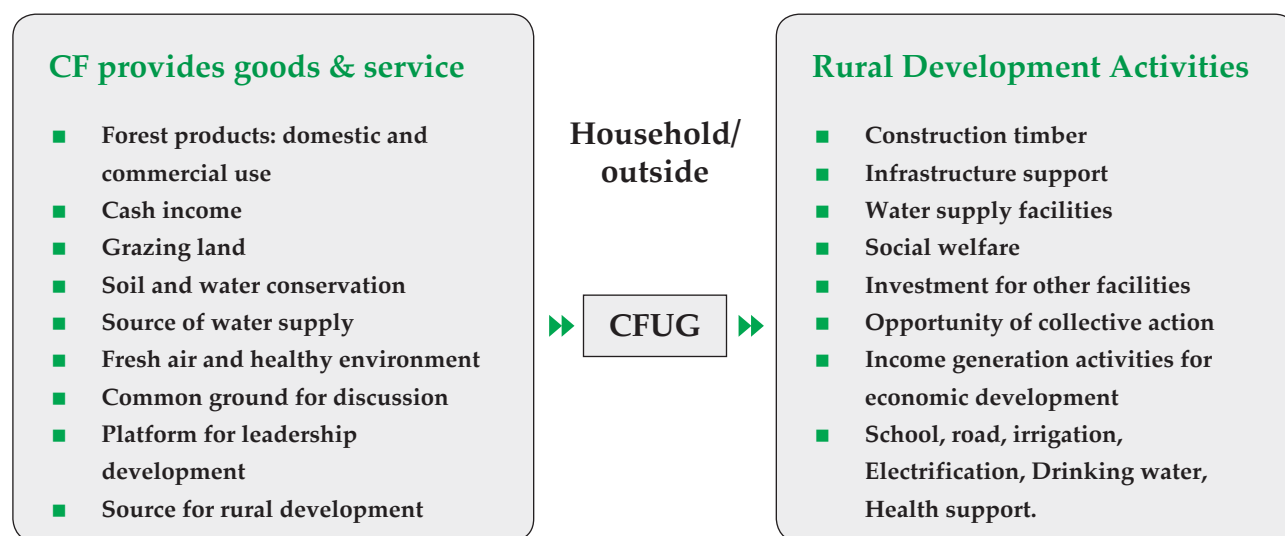


Figure 4: CF contribution in the rural development of Nepal

TABLE 3: CONTRIBUTION OF CF VARIOUS DEVELOPMENT ACTIVITIES IN THREE DISTRICTS OF NEPAL

District	Social Development	Infrastructure Development	Institutional Development	Environment Conservation	Saving
Rupandehi	14 %	10 %	30 %	38 %	08 %
Palpa	18 %	20 %	32 %	20 %	10 %
Parbat	20 %	22 %	34 %	20 %	04 %

Sustainable forest resource management in terms of environmental and economic issues is important for the sustainability of the community. The concept of scientific forest management in community forest is increasing for the production of desirable forest products. Besides the supply of products from community forest, the trends in community development that are emerging are becoming popular. Income generation opportunities in community forestry encourage people towards increasing social unity and strengthening community development. The objectives and focus of community forestry is changing and widening as it matures. Similarly, the management capacity of the FUGs also is improving so that they are able to cope more effectively with their external and internal environments.

6.0 RECOMMENDATIONS

Forest management is the process of managing forests to achieve one or more clearly specified objectives set with regard to the production of a continuous flow of desired forest products and services, without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment (Higman *et al.*, 1999). This is the longer term objective of CFUG but the rural people seem to depend on the forest for short-term benefits and expecting immediate return from forest. For this purpose, the CFUG and GoN need to consider the following points given as recommendation from the study.

- Community cum Public awareness programmes on climate change, global warming, carbon trade and payment for environment service should be introduced and implemented to the CFUG members. It is essential to implement existing community forestry by laws and guideline in utilization of CF funds toward the specified sectors.
- A site-specific operational plan is needed for optimum and judicious use of forest land for the benefit of their users, e.g. product mixes including NTFPs and MAPs as well as grasses.
- Simple and practical forest resource assessment methodology is needed to active participation of CFUGs, therefore Simple and practical OP as well monitoring guideline should be prepare based on the resource condition and desire of users.
- Simple and practical forest resource assessment methodology is needed to active participation of CFUGs, therefore Simple and practical OP as well monitoring guideline should be prepare based on the resource condition and desire of users.
- Most of the community forest is found under-utilised because of the protection-oriented mentality of users and the lack of resource information, support and technical input from DFO staff. Therefore, technical input and support should give in the preparation of OP, period of harvesting and this kind of plan should have realistic and implementable. More monitoring system and mechanism should make to support CFUG from DFO.
- The uses of alternative energy resources should be increased from the GoN policy and CFUG operational plan, so that local people can use biogas, solar power, improved hearth for cooking, hydroelectricity rather than forest products.
- Agroforestry (planting of trees along with the NTFP/ MAP as well cash crops) programme should be promoted in the CF area.
- There is a lack of base line information on biodiversity issues; therefore, it is extremely difficult to access the change brought by the community forestry. The baseline studies addressing current status, trends and threats to biodiversity should be conducted. Managing community forest should look elsewhere the basic needs requirement i.e., towards generating financial, physical and social capital.
- The establishment of a participatory implement of plan, monitoring and evaluation system for forest management is a crucial aspect of CFUG, therefore DFO should focus on production and use of forest resources in the appropriate and effective manner.
- As we know that management of forest resources for multiple uses, more emphasis should be placed on desirable and site-suitable seedling production in the CFUG nursery to plantation and technical input on the promotion of natural generation too.
- Design and develop pilot and demonstration forest management sites for practical experience become most urgent, therefore first of all need support for CFUGs and field staff for an action learning approach to scientific forest management that considers potential benefits for livelihoods promotion and sustainable utilization, which help in the pilot forest management site.
- Effective monitoring & supervision mechanism as well as regular technical assistance is essential to the smaller CF.

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A Protected Species (*Pterocarpus marsupium*) Triggered Biodiversity Conservation in Community Forestry in Nepal: A study in Kanchanpur district in Nepal

Pashupati Nath Koirala¹ and Dipesh Pyakurel²

Abstract

Pterocarpus marsupium Roxb. (Bijayasal) is a medium to large sized deciduous tree with ecological, economic and medicinal value. An empirical study was carried out to identify ecology and population of *P. marsupium* at Kanchanpur district. It is distributed in the foothills of Siwalik and in the flatlands of Terai, all in Community Forest (CF)s, Government Managed Forest and Suklaphanta Wildlife Reserve. There are more than 395 mature Bijayasal trees in the surveyed 12 CFs. The average numbers of mature trees are nine to ten per 100 hectare. The highest numbers of mature trees are recorded from Bedkot CF, Daiji-5 with 98 trees. The species is mostly associated with Sal (*Shorea robusta*) and scattered either in the pure Sal forest, or Sal mixed with other tree species like Karma (*Adina cordifolia*) and Sindure (*Mallotus philippensis*). Other minor associates are Rajbrikshya (*Cassia fistula*), Saj (*Terminalia alata*), Sissoo (*Dalbergia sissoo*), Khayar (*Acacia catechu*), Kusum (*Schleichera oleosa*) etc. The conservation has initiated and contributed into biodiversity conservation because of no grazing and fire protection including protection oriented forest utilization practices. Occurrences of forest fire inside community managed forests have been reduced dramatically through community mobilization and equipment support in the Terai foothills after initiation for on conserving the *P. marsupium*. Similarly, about one fourth of community forests in the district have already declared the zero grazing and about 70 per cent areas have been conserving without grazing permission. As a result, a chunk of about 3000 ha forest land has been declared for biodiversity conservation research areas by District Forest Office, Kanchanpur.

Key words: Bijayasal, Biodiversity, Community Forest, Forest Fire, Zero Grazing

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1.0 INTRODUCTION

1.1 Biology

Pterocarpus marsupium Roxb. (Bijayasal); family Fabaceae; is a medium to large sized deciduous tree that grows up to 15-25 meters in height. Leaves compound, elliptic or ovate to lanceolate; flowers yellow; pod orbicular (Duthie, 1915). Flowering occurs during August to October and fruiting on January to April. Bark grey to dark brown with swallow cracks. The bark exudes a red gummy substance (gum resin) when injured (Yadav and Sardesai, 2002).

1.2 Distribution of *P. marsupium* in Nepal

P. marsupium is found to grow naturally in the deciduous tropical forests of mid and far-western Nepal within the altitude of 100 to 500m. *P. marsupium* has very limited distribution and does not exhibit thick stocking. It is documented from Kanchanpur, Kailali, Kapilbastu, Rupendehi, Nawalparasi, Bardiya and Jhapa district (www.eson.org.np). However, the natural distribution in Jhapa is obscure. It is found in deciduous forest both on undulating and flat ground and grow on variety of formations if the drainage is good.

1.3 Conservation

The major threat to its natural population is low germination percentage and cutting and felling for various purposes. The natural regeneration takes place by means of seed but the germination percentage is less than 30% (Kalimuthu and Lakshaman, 1995). The conventional seed and vegetative propagation of the tree has not been very successful due to hard fruit coat, less germination percentage together with poor viability. Likewise, it was indiscriminately cut and fell in the past for economic purpose (handicraft), medicinal (especially for Kino gum) and fodder (cattle love to feed on the leaves).

Due to overexploitation of the tree for its various useful application coupled with low germination, Government of Nepal, under the Forest regulation 1995 (amended in 2001) banned *P. marsupium* for felling, transportation and export. It is critically endangered in Nepal (IUCN, 2001, CAMP, 2001). It is also kept in the "Red List" by India (Choudhuri and Sarkar, 2002). *P. marsupium* was listed endangered by IUCN and entered to Red list in 2006 (IUCN, 2006).

Sensing that the availability of *P. marsupium* is declining in western Terai/ Bhabar mixed hard wood forest, Government of Nepal had attempted its *in-situ* gene pool conservation through tree improvement programmes. The result is however, obscure. *In situ* conservation of *P. marsupium* is till date effective in northern parts of Suklaphanta Wildlife Reserve (GoN, 2002).

1.4 Objectives

P. marsupium, a plant with high medicinal and economic value, is very sparsely distributed even in its pocket areas. Despite this, there are very few study carried out in regard to its ecology and distribution. It would be difficult to prepare any management or conservation plans for Bijayasal without understanding its population dynamics. On this background, the study was carried out at Kanchanpur district with major objective of identifying the population, ecology and pattern of uses with biodiversity value of *Pterocarpus marsupium*. Further, the study also observed in biodiversity impact after conserving the trees. It may be defined the co-benefits of the species conservation initiation.

2.0 METHODS

2.1 Assessment Methods

A participatory approach was followed for information collection, including consultation with concerned staffs and forest user group members. The key informant interviews using checklists, resource mapping, focus group discussion, transect walk, key informant interviews and household interviews was adopted for field data collection. Participatory forest/NTFP inventory methods and guidelines, as explained by various authors (and DoF, 2012) were reviewed to design the actual field study.



Plate 1: Bijayasal tree in wild form (Photo: Dipesh Pyakurel)

Study sites were selected as per the outcomes of the consultation with officials of District Forest Office, CF members and local community people. A group of people, assisted by Forest Watcher (a locally hired forest guard by community forest to look after the forest) were involved in the resource mapping exercise. The map printed in CF operational plan was used as reference map during resource mapping exercise. The local people were asked to draw resource maps on the availability and populations of Bijayasal. The potential areas were visited for detailed inventory.

Consultation was done with knowledgeable persons before the study and the area of availability was identified, followed by pin pointing the exact location of availability. With this approach, about 40% of all available trees were individually studied, counted and surveyed. The total number of trees in the district was estimated by exact counting and remaining 60 % was taken as extrapolation.

Data obtained from the field was processed and analyzed manually to find out the population of Bijayasal in Kanchanpur district, its regeneration etc. Microsoft excel software was used to carry out most of the calculations and to draw charts.

Regeneration study estimate the time required for seedlings to replace harvested individual plants. Same plot was used for the regeneration study, quantification of stock and calculating the density. Seedlings and saplings of targeted NTFPs were individually recorded and analyzed to find out the density and frequency of seedlings and saplings.

2.2 Study Area

The study for Bijayasal was focused mostly on the community forests (CFs) of Kanchanpur district. A total of nine CFs (Table 1) were directly surveyed. As Bijayasal is found mostly in the foothills, the studied CFs were in Bhabar and the northern Terai. In the meantime, the triggered impact areas were observed as an integral part in the wildlife animal conservation, grazing status of CFs and forest fire incident status.

3.0 RESULTS AND DISCUSSION

The results have been explained more in the Bijayasal species' status and its position of the regeneration including the triggered impact on biodiversity conservation in the stretch of the forest assessment zones.

3.1 Ecology

Bijayasal is found to be associated with Sal (*Shorea robusta*) in all the surveyed CFs. Bijayasal are scattered either in the pure Sal forest, or Sal mixed with other tree species like Karma (*Adina cordifolia*) and Sindure (*Mallotus philippensis*). *P. marsupium* often grows taller than the Sal that enables Bijayasal to widely disseminate the seeds, which is further aided by the structure of seed which are winged and very light. Likewise, the minor associates were Rajbrikshya (*Cassia fistula*), Saj (*Terminalia alata*), Sissoo (*Dalbergia*

TABLE 1: COUNTED AND ESTIMATED NUMBER OF BIJAYASAL MATURE TREES IN SURVEYED CFS

Name of CF	Area of CF	Surveyed Trees	Estimated number of Trees	Average number of mature tree per 100 hectare (estimated)
Baijanath CF, BMC-1	222.04	6	8	2
Sahid Smriti CF, BMC-3	291.95	46	98	20
Baijanath CF, BMC-9	212.13	11	19	
Siddhanath CF, BMC-9	497.98	13	27	5
Baitada CF, Daijee 4	484.60	10	10	2
Siddha Baijanath CF, Daijee 4	582.8	7	19	
Bedkot CF, Daiji-5	261.9	41	120	11
Gwalabari CF, Krishnapur -2	198.82	11	16	
Janahit CFUG, Krishnapur VDC -2	192.0	7	11	
Others (12 trees at Amarjeet CF, Krishnapur 1; 3 trees at Birendra CF; etc)			55	
		152	383	

sissoo), Khayar (*Acacia catechu*), Kusum (*Schleichera oleosa*) etc. Sissoo and Khayar associate Bijayasal in the riverine areas; whereas, Saj, Rajbrikshya and Kusum associate Bijayasal in the core forest area, but their association was limited.

3.2 Population and Regeneration

The number of mature trees is very scarce in all surveyed areas (table 1). Natural regeneration was also very limited, even in the natural available areas of Bijayasal. The total number of surveyed trees was 152 (40% counting of available mature trees) and based on this, the number of mature trees was estimated to be 383 in the community forests of Kanchanpur district. All the available trees are mature and big sized. The average Diameter at Breast Height (DBH) of surveyed trees was 98.5 cm and the average height was 23.7 m.

Bedkot CF and Sahid Smriti CF were identified as the pocket areas for mature trees; whereas, Baijnath CF of Brahmadev was identified as the pocket area for naturally regenerated Bijayasal. Gwalabari CF was also the pocket area for naturally regenerated seedlings and saplings. There are substantial numbers of Bijayasal in private lands. More than 25 mature trees are recorded from BMC-1 (near Baijanath CF, BMC-1), five trees in BMC-3 (nearby Sahid Smriti CF, BMC-3), seven trees from Daiji-4 and few cultivated by individuals.

Bijayasal, in most of the cases, is recorded foothills of Siwaliks and is rarely found in the slope above 30 degrees. Less than one per cent of surveyed trees are recorded from the slope of 30 degree. During the survey at Kanchanpur district, it is mostly found below the altitude of 300m.

Bijayasal has very limited natural regeneration. The number of saplings and seedlings were very low. Only 10 to 15 saplings were recorded from the CF with the area of more than 200 hectare. The numbers of naturally regenerating seedlings are almost null. The underlying reason might be: (a) very low regeneration of Bijayasal due to low viability, (b) requirement of adequate exposure and sunlight which is very low in fully grown Terai Sal forest, (c) open grazing, and (d) excessive use for fodder.

However, the natural regeneration was excellent in Baijanath CF, Brahmadev of BMC- 9. There are more than 800 saplings of Bijayasal in this CF, which is by far the highest number of sapling recorded during the survey. The grazing was prohibited for last four to five years and fodder and fuel wood collection was also controlled in that particular CF. With this, it can be anticipated that control in open grazing can enhance the natural regeneration of Bijayasal.

Gwalabari CF also has good natural regeneration of Bijayasal. There are more than 78 saplings (below DBH 5 cm) within 200 sq. m (however in only one plot). Likewise, there are 300 counted seedlings in five ha. area within Gwalabari CF.

3.3 Biodiversity Value

Pterocarpus marsupium is a multipurpose tree. Medicinal value includes gum, leaves, bark, heartwood, flowers and seeds have medicinal uses (www.eson.org.np). The paste of seed and wood/heartwood is useful in diabetic anemia. Wood of the tree is useful for diabetic patients. Likewise, heartwood is astringent, bitter, acrid, cooling, anti-inflammatory, depurative, haemostatic, revulsive, anthelmintic, constipating and rejuvenating. The gum resin of *P. marsupium* is the only herbal product ever found to regenerate beta cells that produce insulin (Kino gum) in the pancreas. Heartwood and gum is considered to be useful in diabetes, skin diseases, blood diseases, rejuvenator, diarrhea, dysentery and toothache (Mishra, 1993). Local residents of Kanchanpur are using Kino gum for body and joint pain, both internal and external.

Similarly, the leaves are high palatable for livestock and is posing threat to its natural regeneration. Ecologically, it provides food to birds and mammals; it is Vulture's vantage point (due to very tall tree); and it is the climax partner of *Shorea robusta* (during climax succession).

Its economic value has escalated in the recent years, mainly due to the use of timber. It is being used in preparing in preparing Cup, Theki, utensils and other wooden decorative items. It is growing popularity amongst the Nepalese and Indian citizens. The District Forest Products Supply Board, Kanchanpur's has fixed the selling rate of round timber at NRs 493.16 per cubic feet. The entrepreneur purchase at NRs 1500-1900 per cubic feet (as per the entrepreneur) from the middle traders who buys from the private owner and community forest user group. About ten cups can be made from a cubic feet timber and it is being sold NRs 500 to 700 per piece and for a Theki it is much high price up to NRs 1500. The local community uses its timber to manufacture agricultural utensils such as plough.

Owing to its high use in recent years, it has posed threat to the sustainability. The main reasons for unsustainability are its slow growing (took more than 60 years to mature) and very low germination percentage. Thus, the conservation and management is mandatory for this species, which is discussed in the below.

3.4 Conservation Initiative

A good initiation was observed with tagging of trees in Sahid Smriti CF, Barkunda, where 98 healthy and mature trees were tagged, and GPS readings were recorded. An artificial regeneration promotion is being carried out in Sayapatri CF, Krishnapur-6. There were so many CFs with almost no grazing and a few of them have declared zero grazing option inside the forest areas along the stretch of the Bijayasal populated areas.

3.5 Triggered impacted areas in biodiversity conservation

The Bijayasal conservation initiation made a success in Kanchanpur to conserve and manage the forests and resulted towards co-benefits such as wetland conservation; wildlife conservation; control in grazing and forest fire. Similarly, in the north east of the foothills a range of Sisne areas has been declared from the DFO as a Biodiversity Research Area (BRA) in January, 2015 which has more marshland suitable for the wild animals and migratory birds. The declared area includes about 3000 ha forest stretch strategically importance to link the Siwaliks and Terai. A Community Forestry Coordination Committee (CFCC) of say eastern command of the Kanchanpur district is looking for to develop the area implementing a management plan.

At the same time, a tiger sighting was captured in camera trapping in the Gwalabari and Janahit CF stretch recently. The Janahit CF is very active CFUG for Bijayasal and wildlife conservation. Tiger pug marks were observed in 2014 and 2015 including one horned rhino and several other wild animals.

Similarly, Out of 110 CFs, 73 CFs-13,339 ha, have initiated to ban the grazing inside the forests and about 3000 has forest areas have already been declared zero grazing themselves (DFO Kanchanpur, 2015). They declared zero grazing and grazing banned CFs are located in the Bijayasal Conservation Areas (BCA). Meantime, a data was collected to observe the forest fire which has revealed an only eight per cent forest area of the CFs were affected from the seasonal forest fire; whereas, it used to be more areas burning annually before time.

3.6 Conservation Threat and Gaps

Leaves and twigs are collected to feed the cattle. Likewise, lower part of mature trees were found exposed and gums are running from wounds, indicating the excessive collection of the Kino gum by slashing the bark and exposing the heartwood. Still, inadequate awareness regarding its ecological and economic importance is regarded for conservation challenges.

4.0 CONCLUSION

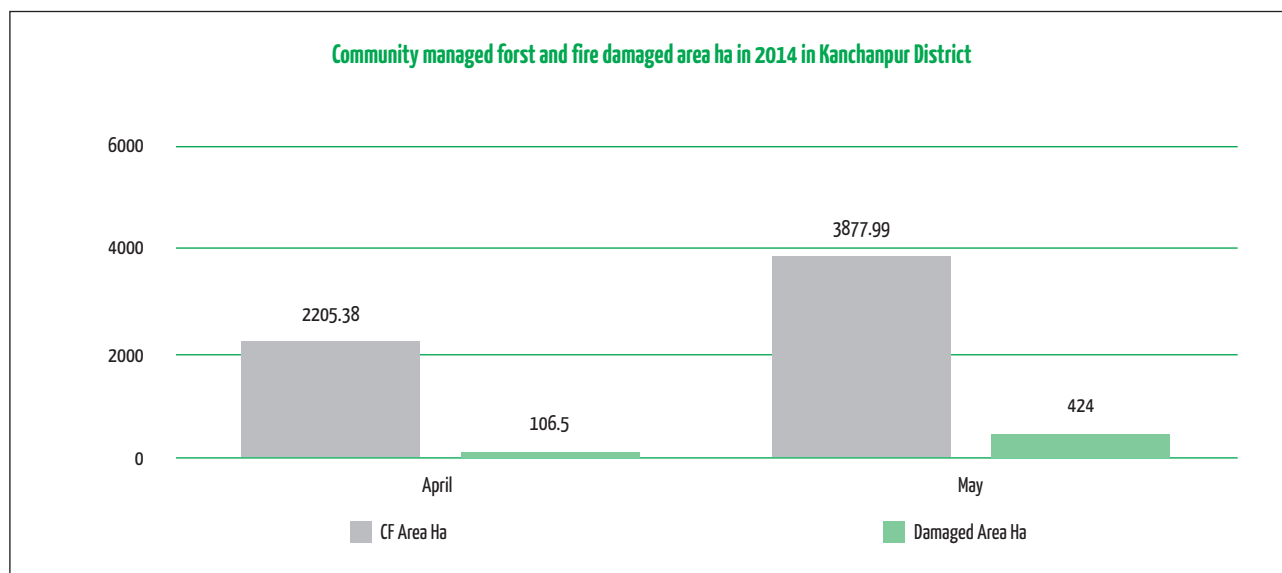
The conclusions are also observed into two themes: plant species conservation and its impact on the biodiversity management.

4.1 Bijayasal conservation

Bijayasal has very limited distribution and natural regeneration. Cattle feed on leaves of Bijayasal and thus the regeneration is highly effected. The natural regeneration is further hindered by low germination percentage of Bijayasal seeds. The natural germination is less than 30 %.Distribution of Bijayasal is very limited even in the pocket areas. Highest numbers of mature trees were recorded in Bedkot CF followed by Sahid Smriti CF with the number of 120 and 98 respectively. Bedkot CF and Sahid Smriti CF were the pocket areas for mature trees whereas Baijanath CF of Brahmadev is the pocket area for naturally regenerated Bijayasal. Gwalabari CF is also the pocket area for naturally regenerated Seedlings and Saplings. The conservation plot of 2.91 hectare was established in Sayapatri CF, Krishnapur-6. Likewise, there are 98 trees tagged in Dhaulepani National Forest area of Krishnapur VDC ward no 1.



Plate 2: Tiger captured in camera trapping on 19th April 2014 in Laljhadi Protected Forest in Kanchanpur (Photo: Terai Arc Land Programme, 2014, Dhangadi)



Graph 1: Community managed forest and fire damaged area ha in 2014 in Kanchanpur District (Source: DFO Kanchanpur, 2014)

4.2 Impact and extent of biodiversity conservation

A variety of species conservation has made the community user groups to heed the other issues together for forest conservation which resulted to conserve the forest resources, wild life and wetlands. The Bijayasal is much sensitive against forest fire and grazing therefore the species conservation initiation triggered the strict conservation through declaring zero grazing, controlling forest fire including conserving the wetlands. After

conserving the whole tract of the forest then there could be developed the right habitat for wild animals like Tiger and Rhino too. Finally, the local community group was motivated to declare an area for further research site for priority giving wildlife conservation and the DFO, Kanchanpur declared a site named Sisne about 3000 ha as a Biodiversity Research Area. In conclusion, there is only possible conservation through collaborating management of both climax species together such as Tiger and Bijayasal (climax partner of *Shorea robusta*) for the better result in biodiversity conservation.



Plate 3: The exposed bark of Bijayasal for gum. (Photo: D. Pyakurel, 2014)

5.0 RECOMMENDATIONS

The study and review recommends to assess Bijayasal in other potential districts like in Kailali, Kapilbastu and Rupandehi and to test pharmacology of wood tan for curing various diseases and illness. Regeneration methods through tissue culture and other methods are to be adopted for the further promotion including awareness campaign on the biological value and trial plot establishment in private lands, CF and government forests. Moreover, a detailed ecological analysis in the areas where seedlings and saplings are present (detail soil characteristics including micro and macro nutrients, soil pH, moisture; open space for regeneration; seed viability in days/months/year) is to be carried out.

Similarly, the study also triggered to think on collaboration and coordination among plant and animals; thus, it is recommended to save future is possible through beginning conservation of the surrounding wetlands, wild tree and wildlife for wilderness. However, to sustain the livelihoods for local forest users it is needed to generate the income through ecotourism activities and alternate livelihoods services.

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Crested Kingfisher by Jyotendra Jyu Thakuri



SECTION II

Biodiversity and Ecosystem Services: Neglected aspects of the community forestry systems in Nepal

Chhotelal Chowdhary¹ and Rajendra K.C.²

Abstract

Community forestry is one of the most important and participatory forest management systems evolved in Nepal that restores degraded lands with trees, provides habitats for flora and fauna, recharges water sources and acts as the corridor for wild animals for their genetic exchange to maintain within species diversity. Community forests play a vital role in maintaining ecological balances as well as economic development in Nepal throughout all geographical regions. Churia- Terai representing 12.78% area of Nepal provides various goods and services for the economic wellbeing of forest dependent people. The biological resources of the community forests of Terai and Churia forest ecosystems are home of 666 different Non-wood Forest Products species of flora and 74 species of animal origin. Community forests are important natural resources contributing to ecosystem services such as carbon sequestration and hydrological services. Likewise, community forests links upstream and down streams river systems and thus reduce disaster and climate induced vulnerabilities such as deposition of silt in agriculture lands, loss in productivity and aggregation in rivers.

This paper aims to explore the biodiversity and ecological services of community forests of Churia and Terai. Data were collected by extensive desk review and analyses of secondary information. Government approved "Five-year Forest Management Plan" of 21 districts; Community Forestry Operational Plans, Community Adaptation Plans of Actions (CAPA) were extensively reviewed. Primary data were collected by organizing open structured discussion and interview with community forest user groups and district forest office staffs. It is found that a large number of tangible and intangible benefits have been regularly withdrawn by the community and local stakeholders from the community forestry programme. Despite numerous tangible benefits from community forests and its record maintenance; its ecological values and importance such as carbon sequestration, hydrological services, aesthetic and spiritual parts are partly missing and largely forgotten from the prevalent Community Forestry Programme. However, the biodiversity conservation and ecosystem services are potential treasure of community forests to link with the socio-economic well-being of the community and nations.

Key words: Community Forestry, Biodiversity, Ecosystem Services, Terai, Churia (Siwaliks), Upstream-Downstream Linkages

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1.0 BACKGROUND

Community forestry is one of the most successful forestry programme in Nepal. As one of the pioneer of modern community forestry programme, Nepal has been successfully implemented it since 1978. The master plan for forestry sector (1989-2010) provided the topmost priority to the community forestry programme in the overall forestry sector in Nepal. The Forest Act-1993 and Forest Regulation-1995 have also provided prominent grounds for the successful implementation and expansion of the forestry programme in Nepal. As a result, Nepal is considered as the pioneer and most esteemed country in the world for implementing successful CF programme. A total of 1,798,733 ha. of the national forests have been handed over to 18,960 community forestry user groups (CFUGs) including 2,392,755 households for the conservation, management and utilization of the forest resources (DoF, 2015: Unpublished). The CF programme has been implemented in all five geographic regions of the country including Churia (Siwalik) regions of Nepal.

Churia landscape comprise a total 36 districts (Table 2) and extends from east to west representing 12.78% (1,896,251 ha) of the total landscape of the country (PCTMCDB, 2015). The Terai region further occupies the total of 13.6% (2,011,300 ha) of the nation. The Churia and Terai together account for about 60% of the total population of the country (Giri *et al.*, 2012). Churia hills are geologically fragile and ecologically sensitive zone. The Government of Nepal has declared the Churia a special protection region and formed the "President Churia-Terai Madhesh Conservation Development Committee (PCTMCDB)" covering 36 districts in June, 2014 (MoFSC, 2014). The President Churia Terai Madhesh Conservation Development Committee comprises Churia hills (34.1%), Bhabar (14.8%), Duns (9.1%), inner river valleys (2.2%), and Terai (39.8%) (PCTMCDB, 2015). It has significant social, ecological and paleontological value as this region provides important source of biodiversity, fossils and ecological services (Giri *et al.*, 2014; DFRS, 2014; Acharya *et al.*, 2015; Paudyal *et al.*, 2015). In recent years, population growth rate of 1.75%, the highest in the nation, have resulted in heavy pressure on the forest resources of the region (DFRS, 2014).

Biological resources of the community forests of Terai and Siwalik forest ecosystems are home of very important timber, non-timber and wildlife species of national and global significance. The Siwalik regions only comprised of 666 different NWFP species of flora and 74 species of animal (DFRS, 2014a) whereas the Terai forests contain 370 different species of NWFPs (flora 329 and fauna 41) (DFRS, 2014b).

The biodiversity conservation has multiple benefits for the community and nation. It supports from subsistence livelihood to economic development of the society and country. It has a number of ecological services including nutrient cycling and pollination of plants increase in the productivity, pest-insects resistance and aesthetic importance. Further, biodiversity has multifold aspects

to be considered—agricultural productivity, food security, human health and nutrition, indigenous knowledge, gender and social equality, culture, climate, water resources and aesthetic value to the society. The country's biodiversity is also an important source of revenue to the government (MoFSC, 2014).

Churia and Terai are interlinked and lively connection. Churia hills resources such as community forests are very important for the maintenance of the Churia watershed for hydrological benefits to downstream people, and generate much needed background information for setting up payment of ecosystem services (PES) scheme (Kumar, 2014). Despite having high biodiversity and livelihood values, the Community Forestry Systems in Nepal remained neglected until recently (MoFSC, 2014).

The improvement in forest condition under community management is believed to have positively contributed to biodiversity (MoFSC, 2014). There is about 8,936 community forest user groups (CFUGs) handed over in the Churia and Terai regions area which represents 47.1 percent of the total CFUGs (18,960) of Nepal (DoF, 2015 unpublished). However, entire CFUGs' numbers have been included in this list from all 36 districts (Table 2). Community forestry not only reforested degraded forest of Nepal, but also generated many environmental services such as carbon sequestration, hydrological services, and landscape beauty as positive externalities (Paudyal *et al.*, 2012). The deforestation rate has been slowed down in the Churia regions (FRA, 2014a; Helvetas, 2015). This is mainly attributed to the successful community forestry programme in the region. Despite the numerous ecological, social and economic benefits served by the community forests, District Forest Offices and respective CFUGs have still given less priority to incorporate biodiversity and ecosystem services into the forest management plans of Community Forests. This paper aims to highlight the biodiversity conservation ecological services which are largely neglected aspects of community forestry systems in Nepal.

2.0 OBJECTIVES

Main objective of the study was to assess the status and provisions of the biodiversity conservation and ecosystem services in community forestry systems in Nepal, with strong focus to the Siwalik (Churia) and Terai regions of Nepal. Other specific objectives are:

- Assess the biodiversity conservation perspective in the community forestry and other Community Based Forest Management systems in Nepal.
- Assess the biodiversity and ecosystem services potentialities of the community forestry.

3.0 MATERIALS AND METHODS

This study was carried out extensively in 36 Churia

(Siwalik and Terai) districts of Nepal. Churia districts include Churia hills, Bhabar, inner river valleys and Terai. Primarily, Five Years Forest Management Plans of 21 districts i.e. *Jhapa, Morang, Sunsari, Saptari, Udaypur, Dhanusha, Sindhuli, Mahottari, Rautahat, Bara, Parsa, Chitwan, Nawalparasi, Rupandehi, Kapilvastu, Palpa, Dang, Kailali, Kanchanpur, Dadeldhura and Surkhet* were reviewed. Annual Progress Reports of DFOs, Conservation Area Management Plans, Community Based Climate Change Adaptation Plans of Banke and Kailali districts were thoroughly reviewed. Similarly, conservation reports of Churia Management Plan of Jhapa, Conservation Management Plans of Latijhora, Ramdhuni, Jagdishpur, Purandhara, Khata, Surai-Naka were recapitulated. Churia Management reports of Jhapa, Palpa, Banke, Dang and Dadeldhura were examined. Field visit was done and discussion was made with CFUG members, DFO staffs and Buffer zone Management committees in over 15 districts. Besides document review, district level stakeholders workshop was conducted in 28 Churia districts with the participation of most of the major local level stakeholders. In each district level stakeholders workshop, 25 to 40 persons were participated. Several feedbacks and state of the biodiversity and ecosystem services in their respective CF were collected and biodiversity hotspot community forests were identified. Field visit was made in 15 community forest user groups and extensive consultation was made with the CFUG members to tract their contribution to conserve biodiversity and ecosystem. Data were analyzed using simple statistical tools such as MS Excel.

4.0 FINDINGS AND DISCUSSION

4.1 Policies and Strategy for Management of Biodiversity

There are over 35 biodiversity related sectoral policies, strategies, and regulatory framework formulated since 2002. Some of the important policies, strategies and regulatory frameworks implemented by the Government of Nepal are: i) The Tenth Plan (2002-2007) [Poverty Reduction Strategy Paper], ii) National Foundation for Development of Indigenous Nationalities Act (2002), iii) Sustainable Development Agenda for Nepal (2003), iv) Science and Technology Policy (2005), v) Biotechnology Policy (2006), vi) Nepal Biodiversity Strategy Implementation Plan (2006), vii) National Bio- safety Framework (2006), viii) Interim Constitution of Nepal (2007) and Constitution of Nepal (2015), ix) Three Years Interim Plan (2007-2010), x) Three-year Plan (2010-2013), xi) Climate Change Policy (2011), xii) National Land Use Policy (2012), and xiii) Environment Friendly Local Governance Framework (2013).

Other major legal documents and strategies are i) Nepal Biodiversity Strategy (2002), ii) Water Resource Strategy (2002), iii) Mountaineering Expedition Regulations (2002), iv) Leasehold Forest Policy (2002), v) National Agricultural Policy (2004), vi) Herbs and Non- Timber Forest Products

Development Policy (2004), vii) Rural Energy Policy (2006), viii) Agro-biodiversity Policy (2007), ix) Plant Protection Act (2007), x) Tourism Policy (2009), xi) Plant Protection Rules (2010), xii) Forest Fire Management Strategy (2010), xiii) Industrial Policy (2011), xiv) Rangeland Policy (2012), xv) National Wetlands Policy (2012), xvi) Forest Encroachment Control Strategy (2012), xvii) Wildlife Damage Relief Guidelines (2012), xviii) Irrigation Policy (2013), xix) National Biodiversity and Action Plan (2014-2020) and Forest Policy 2015.

These all policy, strategies and legislations directly or indirectly contribute to biodiversity conservation, poverty reduction, climate change mitigation and ecosystem conservation. The National Biodiversity Strategy and Action Plan (2006 -2020) is the comprehensive strategy prepared with a 35-year vision of "conservation of biodiversity for sound and resilient ecosystems and national prosperity". The overall goal is to significantly enhance the integrity of Nepal's ecological systems by 2020, thereby contributing to human well-being and sustainable development of the country. This is to be achieved through implementation of a number of sector specific and cross-sectoral strategies and priority actions. Recently promulgated Forest Policy 2015 also promotes the inclusion of the biodiversity conservation and ecosystem services. However, the levels of implementation of all these documents are very poor. The community forestry systems (formulation, implementation, monitoring and evaluation and reporting parts) lack the biodiversity conservation and payment for ecosystem services.

4.2 Coverage of Forests/Community Forest in Churia and Terai regions

Community forests, leasehold forests, collaborative forests, religious forests, private forests and protected forests have significant role in conservation of biodiversity in Churia and Terai area benefitting to the millions of local people. There are six different forms of the participatory forestry/social forestry management in the regions such as community forests, leaseholds forest, private forest, religious forests, collaborative forest and public land forestry management. Further it shows that number of community forests handed over in Churia districts are 8,958 representing 1,073,485 ha of national forests. However, a total of 2720 CFs representing the 485,708 ha. area lie in the Churia hills (Table 2).

Besides, there are over 2165 leasehold forest user group, 3017 number of registered private forests, 499 groups of public land forestry management, over 68 religious forests and 24 collaborative forests. The table 1 and 2 demonstrate the number of participatory forests handed over in the Churia districts of Nepal.

All of them are very important for the conservation of floral and faunal biodiversity. However, there are almost no provisions of the biodiversity and ecosystem services in their management/operational plans. Very

low level of the awareness exist among the communities in the conservation, utilization and potential benefits of the biodiversity and ecosystem services from their efforts of forest management. There is not much concrete programme, plans and activities directly targeted to the biodiversity conservation and conservation/management of ecosystem services.

TABLE 1: CONCISE INFORMATION ABOUT VARIOUS FORESTS IN CHURIA AND TERAJ DISTRICTS

SN	Type of forests	Number	Area (ha)
1.	Community Forests	8,958	1,073,485
2.	Leasehold Forest	2,165	12,910
3.	Public Land	499	1,366
4.	Religious Forest	68	1,086
5.	Collaborative Forest	24	67,149
6.	Private Forests	3,017	2,486
Total		14,731	1,158,482

Adapted from various DFOs/DoF Data (Unpublished)

TABLE 2: FOREST COVER IN CHURIA REGIONS OF NEPAL AND HANDED OVER OF COMMUNITY FORESTS

SN	District	Forest area			Area of Community forest			Number of CF		
		Total Forest Area (ha) ¹	Forest in Churia (ha) ²	%	Total CF Area (ha) ³	CF area in Churia (ha)	% in Churia	Total Nu. of CFUG ³	Nu. of CFUG in Churia	%
1	Arghakhanchi	65328	39866	61.02	29002	15794.34	54.46	425	112	26.35
2	Banke	132959	77368	58.19	27943	15433.32	55.23	162	77	47.53
3	Bara	40936	15177	37.07	8162	4553.63	55.79	40	19	47.50
4	Bardia	108337	64924	59.93	18812	10757.33	57.18	278	43	15.47
5	Bhojpur	75788	3	0.00	39026	352.35	0.90	506	3	0.59
6	Chitwan	124651	115386	92.57	18943	12694.78	67.02	71	44	61.97
7	Dadeldhura	115169	29936	25.99	41689	16258.02	39.00	450	140	31.11
8	Dang	181141	155181	85.67	102960	96320.08	93.55	507	461	90.93
9	Dhankuta	36383	316	0.87	29414	937	3.19	362	6	1.66
10	Dhanusha	30898	26685	86.36	8502	6672.69	78.49	36	20	55.56
11	Doti	128920	2879	2.23	33191	1961.27	5.91	215	9	4.186
12	Ilam	80926	27308	33.74	49120	24118.63	49.10	218	89	40.83
13	Jhapa	19459	6288	32.31	12441	3726.03	29.95	46	12	26.09
14	Kailali	205939	126203	61.28	40068	13520.01	33.74	394	88	22.33
15	Kanchanpur	73577	21471	29.18	16359	8078.95	49.39	116	36	31.03
16	Kapilvastu	60830	21550	35.43	5165	632	12.24	77	11	14.29
17	Kavre	46448	516	1.11	18995	2296.59	12.09	411	20	4.87
18	Lalitpur	13200	242	1.83	10928	736.23	6.74	199	18	9.04
19	Mahottari	24501	12772	52.13	6747	6463.88	95.80	75	36	48.00

20	Makwanpur	144558	89996	62.26	64829	25375.61	39.14	361	241	66.76
21	Morang	43814	11652	26.59	11190	6077.44	54.31	84	42	50.00
22	Nawalparasi	104942	75877	72.30	15706	11597	73.84	194	69	35.57
23	Palpa	71170	19241	27.04	33958	9065.8	26.70	634	100	15.77
24	Parsa	73131	51282	70.12	102	64.11	62.85	25	3	12.00
25	Pyuthan	72689	1991	2.74	46668	3210.55	6.88	387	17	4.39
26	Rautahat	29076	7234	24.88	5139	827.44	16.10	37	9	24.32
27	Rupandehi	25432	18593	73.11	18201	4769.64	26.21	88	20	22.73
28	Salyan	128205	28308	22.08	54297	4349.35	8.01	558	37	6.63
29	Saptari	42604	18327	43.02	16867	5231.27	31.01	116	31	26.72
30	Sarlahi	30518	14090	46.17	11638	8774.79	75.40	64	31	48.44
31	Sindhuli	166647	96649	58.00	80795	59310.15	73.41	454	326	71.81
32	Siraha	27708	15793	57.00	14174	7323.76	51.67	89	26	29.21
33	Sunsari	24865	6158	24.77	3718	1090.64	29.33	37	8	21.62
34	Surkhet	178361	87023	48.79	73397	39033.55	53.18	381	265	69.55
35	Tanahu	78111	4	0.01	33229	1076.75	3.24	513	9	1.75
36	Udaypur	120705	87452	72.45	74514	57223.15	76.79	326	242	74.23
	Total	2927926	1373741		1075890	485708.1		8936	2720	

FRA 2014a, ²FRA 2014b; ³Five Years Forest Management Plan of DFOs, Annual Progress Reports (2070/71), Websites of respective DFOs

4.3 Comparative Changes in Forest Cover in Churia Area

Churia is rich of plant species. There are 281 tree species belonging to 177 genera and 71 families, 187 shrub species belonging to 116 genera and 51 families, 322 herbaceous species (including flowering plant and pteridophytes) belonging to 226 genera and 75 families. Altogether 666 different species of flora are used as non-timber forest products in the Churia (DFRS, 2014a).

However, the Forest Resource Assessment report (2014) states that forest cover was decreased by 0.44% per year in 15 years of period (during 1995 to 2010/11) which was greater by 0.04% in the last 22 years (during 1991 to 2010/11). During this period, forest cover was decreased 2.07% in Morang followed by 0.57% in Dhanusha and 0.09% in Sarlahi district. There is also positive changes in forest cover in some districts. Siraha district has forest cover increased by 2.57% followed by Banke with 0.48% and Nawalparasi 0.2%. On the other hand, a study conducted by HELVETAS-Nepal in 2015 shows that overall forest cover in Churia range has increased by 7,500 ha (0.54%) in 22 years. From the both study, it is clear that FRA report shows decreasing trend whereas HELVETAS-Nepal report shows increasing trend of forest cover in Churia in the same period. It might be due to the differences in methodological approaches and definitional differences. Summary of result is presented in the Table 3.

4.4 Carbon Pool in Churia and Terai

Forest is the reservoir of carbon stock in its biomass. It is clear that deforestation causes loss of not only carbon, but also of the biodiversity, disturbed water regulation and destruction of livelihoods of a large number of world's poorest (William, 2003). An estimate shows that the forest of Nepal stores 897 million tons carbon in the year 2005 (FAO, 2005), where community forest contributes 183.39 million tons in the same year (Oli and Shrestha, 2009). Carbon stock in Siwalik and Terai forest was estimated to be 76 million and 36 million metric tons in the year 1988 (HMG/ ADB/ FINNIDA, 1988). Total carbon stock estimated in Churia forest was 160.65 tg and in Terai was 50.68 tg (FRA, 2014) as shown in Table 4. However, none of the community forestry and other community based forest management plans has indicated about the estimation of the carbon stocks, their conservation strategy and possible future trades.

4.5 Community Forestry and Biodiversity

Community forests serve various types of services for biodiversity conservation. The protection of the forests from forest fire, uncontrolled grazing, thefts and illegal harvesting contributes in the conservation of the habitat of various wildlife and biodiversity. Based on the review of Five years Forest Management Plans prepared by various District Forest Offices and district consultation, more than 100 community forests in the study area are found

TABLE 3: COMPARISON OF THE FOREST COVER CHANGES RESULT OF CHURIA REGIONS BETWEEN THE FRA, 2014 AND HELVETAS, 2015 REPORTS

Parameters	Period	FRA, 2014	HELVETAS, 2015
Over all forest cover changes	1991 to 2010 / 11 1995 to 2010 / 2011	-0.4% -0.44%	+ve 0.54%
Positive changes	Nawalparasi	0.2%	Dense forest= 0.22% Sparse forest= 0.07% Riverbed= 1.01%
	Banke	0.48%	
	Sirha	2.57%	
Negative changes	Dhanusha	-0.57%	Water bodies= -1.13% Bushes / grasses= -1.30% Cultivated land= -0.28%
	Morang	-2.07%	
	Sarlahi	-0.09%	

Source: DFRS 2014, HELVETAS Nepal, 2015

directly and significantly contributing for biodiversity conservation. For example, most of the community forests of Jhapa district have focused on maintenance of the elephant corridor, controlling their immigration into Nepal and conservation of the rare plant species –Latahar (*Artocarpus chaplasha*). Dhanusha district maintains habitat of various wild animals. Similarly the buffer zone community forests of Barandabhar corridor (Chitwan) encourage rhino conservation and ecotourism. Few CFUGs of Rupandehi and Dang districts are working towards the vulture conservation and Simal (*Bombax ceiba*) Tree breeding which is the major habitat and roosting place for Vulture. The CF and CFMs of the Mahottari district working for landscape

management. Bardia, Kailali and Kanchanpur for breeding of wild animals and Kapilvastu and Nawalparasi district for water recharge and downstream conservation. Despite some attempts and remarkable contribution of community forests for biodiversity conservation in some areas, focuses of District Forest Offices and majority of the CFUGs are not involved in conservation, management and utilization of the biodiversity. Very few CFUGs constitutions and operational plans highlight the provision of the biodiversity conservation.

The community forests are mainly managed for the production of the timber, fuelwood and other non-wood

TABLE 4: CARBON POOL IN CHURIA AND TERAI FORESTS

Description	Churia	Terai
Total carbon stocks (in tg)	160.65	50.68
Total Carbon (t/ha)	116.94	123.12
Biomass		
Carbon (t/ha)	84.73	89.18
Total carbon (million t)	116,397,244	36,704,704
CO ₂ equivalent (t/ha)	310.9	327
Litter and debris		
Carbon (t/ha)	0.31	0.28
Total carbon (million t)	425,860	115,242
CO ₂ equivalent (t/ha)	1.13	1.03
Soil Carbon		
Carbon (t/ha)	31.90	33.66
Total carbon in ton	43,822,401	13,853,783
CO ₂ equivalent (t/ha)	117.07	123.53

DFRS/FRA, 2014a; DFRS/FRA, 2014b

forest products. The major focus of the communities, government staffs and many civil society organizations are on the maximization of the timber and fuelwood productions and their equitable distribution. Very few numbers of the CFUGs are found doing extensive consultation about the conservation of the biodiversity, less known flora and fauna species. None of them have considered the perspectives of the habitat management for the endangered and rare fauna species. There are very little provisions of the biodiversity conservation in the approved operational plans of the community. The scientific, collaborative and community forests have unknowingly neglected the biodiversity aspects of the management. Contribution of community forests for biodiversity conservation, landscape and ecological management in selected CFUGs of various districts.

TABLE 5: CONTRIBUTION OF COMMUNITY FORESTS FOR BIODIVERSITY CONSERVATION, LANDSCAPE AND ECOLOGICAL MANAGEMENT

District	Community Forests	Biodiversity Conservation Importance
Jhapa	1. Telpani, 2. Bahuwan, 3. Panchpokhari, 4. Nabajyoti, 5. Thople Biram, 6. Magargadhi bit 1 and 2, 7. Bansbari 8. Budhbare Namuna, 9. Adarsh Namnua, 10. Ichhumara, 11. Haluwagadh, 12. Shanti, 13. Jukeni	<ul style="list-style-type: none"> ■ Elephant corridor ■ Latahar conservation
Sunsari	Ramdhu	<ul style="list-style-type: none"> ■ Vulture conservation
Dhanusha	1. Sunakhari, 2. Aurahikhola, 3. Jaladh, 4. Jagdar, 5. Murgiya, 6. Charnath	<ul style="list-style-type: none"> ■ Sloth bear, leopard, deer, mongoose, rabbit
Chitwan	1. Barabdhbar, 2. Satidevi, 3. Gyaneshwar, 4. Majhuwa, 5. Shidhiganesh	<ul style="list-style-type: none"> ■ Rhino breeding
Rupandehi	1. Gudhwatal, 2. Bounkoti, 3. Shankarnagar	<ul style="list-style-type: none"> ■ Vulture conservation ■ Teak seed orchard ■ Simal breeding seed orchard
Dang	Kalika	<ul style="list-style-type: none"> ■ Vulture conservation
Mahottari	Khayermara Ratu Aurahikhola	<ul style="list-style-type: none"> ■ Landscape ■ Soil conservation ■ Greenery
Bara	1. Sigoul, 2. Halkhorla, 3. Bhakuwai khor Lal	<ul style="list-style-type: none"> ■ Tropical ecology
Kapilbastu	Jagdishpur Tal	<ul style="list-style-type: none"> ■ Aquatic ecology
Bardiya Kailali Kanchanpur	Buffer zone community forest	<ul style="list-style-type: none"> ■ Corridor and habitat for various animals and plants
Rupandehi	1. Debdaha 2. Gajeri Tal	<ul style="list-style-type: none"> ■ Water recharge ■ Downstream conservation
Rautahat	1. Halkhorla, 2. Singoul, 3. Bhaluwai khor Lal, 4. Amlekhganj	<ul style="list-style-type: none"> ■ Forest ecosystem

Sources: Five Year Forest Management Plan (2069/70 – 2073/74 and respective plans) , District Forest Offices, Annual Progress Reports (2070/71) of District Forest Offices

4.6 Community Forestry and Ecosystem Services

Community forests provide various kinds of the ecosystem services. The carbon sequestration, biodiversity conservation, maintenance of the water flow and quality, aesthetic landscape are the few of prominent ecosystem services. Several water sources are found inside the community forests. Large numbers of the sprouts are originated in community forests; water flow of the several streams, lakes and underground recharge have been improved through the revegetation of the bare/naked lands after community forest programmes of Nepal.

The community forest operational plan (OP) has made few provisions for the maintenance of the water sources. In many OPs, the harvesting of the trees, poles and shrubs are prohibited in the fixed distance (20-50m) from river/ stream banks.

4.7 Water Bodies, Wetlands, Cultural and Religious Importance

There are 426 ponds and lakes and 15 wet lands in 26 districts, out of them 15 are in community forest land area, 19 ponds are falling in Churia conservation area. Similarly, there 826 cultural, religious and historic places which are very important in religious and tourism perspectives, out of them 8 are falling in Churia area (Table 6). Their conservation and management perspectives are largely missing in community forest management systems in Nepal.

TABLE 6: PONDS, LAKES, WETLANDS, CULTURAL /RELIGIOUS SITES IN CHURIA DISTRICTS

SN	District	Number of Lakes, ponds other than river exit				Cultural, religious & historic places	
		Total ponds & lakes	Ponds & lakes in CF	Ponds & lakes in Churia	Wetland	Number	In Churia
1	Arghakhanchi	7				14	
2	Banke	15			2	8	
3	Bara	8		1		15	
4	Bardia	7				14	
5	Bhojpur	7				8	
6	Chitwan	17		4		22	
7	Dadeldhura	0				13	
8	Dang	17		3	2	52	
9	Dhankuta	2				13	
10	Dhanusha	27				28	
11	Doti	3				5	
12	Ilam	30	11	1		14	
13	Jhapa	20		3	8	14	
14	Kailali	15		1	1	19	
15	Kanchanpur	20		4		11	
16	Kapilbastu	11			1	46	
17	Kavre	6				32	
18	Lalitpur	10				59	
19	Mahottari	13				42	2
20	Makwanpur	1				26	
21	Morang	4				9	
22	Nawalparasi	48				45	
23	Palpa	5				28	

24	Parsa	6				30	
25	Pyuthan	5				28	
26	Rautahat	12				9	
27	Rupandehi	23				38	
28	Salyan	2				12	
29	Saptari	10	2			19	
30	Sarlahi	23				23	
31	Sindhuli	2				16	
32	Siraha	35				19	
33	Sunsari	-			2	6	4
34	Surkhet	10	2	2		13	
35	Tanahu	1				66	
36	Udaypur	4				10	
Total		426	15	19	16	826	6

Source: District Profiles, Five years forest Management Plans of respective districts, <http://www.illamonline.com/category/about-illam-district/lakes-ponds-in-illam>, <http://www.nepallake.gov.np/edr.php>; district consultation

4.8 Efforts Made by DFOs for Biodiversity Conservation

Out of the 21 five years Forest Management Plans reviewed, all the plans have mentioned that DFOs conduct awareness raising activities on anti-poaching, trapping, and killing of wild animals in coordination with Buffer zone management committee, where there are Buffer zone Management Committees. Forest types, growing stock and management methods are mentioned in the plans. Availability of Non-Wood Forest Products, their inventories and trades are mostly incorporated in the Forest Management Plans, and they are also mentioned in the CF operational plans. However, these estimations were mostly made without any scientific methods. Therefore it lacks the higher level of precision. Identification of habitats of wild animals and valuable NWFPs for conservation are clearly explained. Capacity building of CFUG members through training on importance of biodiversity and rewarding of informants against wildlife poaching and killing are also explained.

4.9 Neglected Aspects of Biodiversity and Ecosystem Services

Conservation strategies of Nepal have been largely based on a people exclusive or "wilderness protection" approach (Budhathoki, 2003). Development of community forestry has contributed to conservation of habitat of the wild animal, breeding of them and corridor management (Pokhrel and Shah, 2008). Conservation and management of forest products are described in detail, however conservation of wild animals are not elaborated in the operational plans. There is no elaboration and provision about the management of wildlife in CF operational plan as it is considered the state property. After handing over of community forests to the community, management and

utilization ownership is handed over to them including judiciary right for controlling the illegal works of timber. However, in case of wild animals, rights to take actions against wildlife offences are not handed over to the community.

The forest management plans does not speak about conservation of the genetic and species diversity of flora and fauna. There is very little consideration about the maintenance of the rare and endangered species of the flora and fauna. The harvesting plans do not consider about the maintenance of the superior genotypes, quality timber and well balance between various tree species. The major focus of the forest management is focused only for few timber species such as *Shorea robusta*, *Dalbergia sissoo*, *Acacia catechu*, *Terminalia alata* etc. Rest tree species are considered "Inferior-wood (Ku-kath)" and mainly cleared during cleaning and thinning operations. These so-called low grades, lesser use species might have been various uses and benefits in the long run. There is very few or no attentions are paid for low income species, although they are also the part of biodiversity. Many valuable non-wood forest products are generally eradicated without the knowledge of their potential uses during cleaning operations. The well balance between the conservation of the biodiversity, ecosystem services and productivity have been less emphasized in the community forestry systems in Nepal. However, they are providing positive results in many cases. There is also not much included about various ecosystems being provided by the forests. There are not sufficient attentions paid for the conservation, management and utilization of ecosystem services in CF operational plan. Although there is increasing concerns of PES from Churia to 'Dasgaja' (No Man's Land between India and Nepal boarder) especially for water and soil conservation, no consideration has been taken yet.

5.0 CONCLUSION

Despite community managed forest are effective way to conserve the biodiversity and fulfill the needs of local people and sufficient policies, laws and strategies in place, implementation status and coordination among various stakeholders are weak. District Forest Offices have poor information systems and technologies available to identify, manage and utilize the biodiversity effectively. Forest technicians have limited knowledge on the complex relationship between community forestry and biodiversity conservation as well as ecosystem management. There are limited trained human resources available. Insufficient knowledge and understanding of mountain ecosystems, lack of long-term vision, and inadequate financial resources and technical capacity are some of the major gaps and constraints in the sustainable management of Nepal's Churia and Terai ecosystems. District Forest Offices and CFUGs provide the high priorities for commercially important major forest products. Payment for ecological services is yet to explore in the community forests. The biodiversity parts of the community forestry are generally missing or forgotten from the management plans. There is inadequate information available on the status and trends of rangelands and wetland biodiversity inside community forests (MoFSC, 2014). Hence, biodiversity conservation, payment for ecosystem services and other environmental conservation perspectives/ are urgently required to incorporate into the Community Forestry forest operational plans, Five Years Forest Management Plans and Conservation plans of all districts of Nepal.

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Faunal (mammal) Diversity and Human Wildlife Conflict in Community Forests

(A case study from Tanahun and Kavrepalanchok districts, Nepal)

Bishnu Prasad Shrestha

Abstract

The study was carried out in Tanahun and Kavrepalanchok districts with the objectives of assessing faunal (mammal) diversity and human wildlife conflict (HWC) in community forests (CFs). Questionnaire survey, key informant interview and focus group discussion (FGD) were the main methods to collect primary data. Secondary data were collected from the office records of district forest office, Tanahun and Kavrepalanchok; Regional Forest Directorate, Community Forest User Groups. District five year forest management plan of Tanahun and Kavrepalanchok, and operational plans of community forests, published and unpublished documents related to study were reviewed thoroughly. Collected data were analysed by qualitatively and quantitatively. A total of 15 & 17 species of mammals were found in CFs at Tanahun and Kavrepalanchok respectively. 100% of the respondents agreed that the wild animal has noticeably increased due to establishment of CFs. A total of 14 people including six women were killed by leopard in Kavrepalanchok during the last six years. Similarly, 6 people were injured from leopard and wild boar in Tanahun and Kavrepalanchok. Likewise, a total of 28 livestock were predated from leopard during the last six year. A total of 14 leopards, 4 wild boars and 6 barking deer were killed by human in Tanahun and Kavrepalanchok during the last six years period. From the 6-year data, leopard is found as the most problematic wild animals in CFs. The HWC in CFs is becoming a serious threat to the survival of endangered species as well as welfare of local people. It is found that HWC mitigation networks at district and ilaka level at Tanahun to minimize the conflicts. Public awareness programs like cluster level orientation, FM/radio program, school teaching program and hording board establishment were also conducted by district forest office, Tanahun to reduce the conflict. Provision of instant delivery of relief to the loss, immediate rescue mechanism, public awareness, inclusion of HWC in operational plan, bundling of community forests to manage wildlife and establishment of community based relief fund are recommended.

Key words: Mammal Diversity, Human Wildlife Conflict, Community Forests, Community Network

1.0 BACKGROUND

Nepal's unique geography with its dramatic changes in elevation along the relatively short (150-250 km) north south transect and associated high variability in the physiographic and climatic conditions have resulted in a uniquely rich diversity of flora and fauna in the country. In Nepal, biodiversity is closely linked to the livelihoods and economic wellbeing of millions of rural people who directly depend on natural resources for meeting their daily subsistence needs and cash income (MFSC, 2014).

The community forests management approach in Nepal is one of the most cited success stories for managing common property resources. It has been argued that the approach is successful in terms of restoring degraded land and habitats, conserving and increasing biodiversity, increasing supply of forest products, empowering of women, poor and the disadvantaged groups, generating rural income, and developing human resources (Acharya, 2003; MFSC, 2013; Springate-Baginski *et al.*, 2003). Although community forestry program has focused more on protection and production of forestry related needs for its user rather than conserving existing biodiversity (Belbase, 1999), it is perceived that it has contributed to biodiversity conservation (Adhikari *et al.*, 2004). (Pokharel *et al.*, 2005) claimed that community forests have improved overall forest conditions including biodiversity. Pandey (2007) found comparatively higher tree species diversity on community-managed forest stands than the national parks and government managed forests. The protection of degraded forest through community forestry has improved forest condition in the hills of Nepal and has positive impacts on biodiversity conservation (GoN, 2002; Malla, 2000). Similarly, the increased greenery in the hills has positive impact in conserving water sources and controlling soil loss. Till now about 1.7 million hectares of forest have been conserved, managed and utilized by 18,324 community forest user groups. About 35% of the total population of Nepal is involved in the community forestry process (NPC, 2015). The quality of the forest has been increased (species diversity, forest health and vitality) because users carry out many silvicultural operation for the benefit of forest crops like thinning, pruning, cleaning and plantation, fire line (MFSC, 2013). A study in the Koshi Hills in the eastern region showed that in 93% of the CFUGs the forest condition, growing stock, forest cover and availability of forest product and status of biodiversity has increased significantly. Total number of stems per hectare has increased by 51% and the basal area by 29% (Chapagain *et al.*, 2009). There are many instances that wildlife population has increased in community forests of mid-hills and led to wildlife depredation problem among the farmer and surrounding residents (MFSC, 2013).

Human wildlife conflict is the interaction between human and wild animals with its consequential negative impact on people, their resources, or wild animals. The conflict crops up when humans or wildlife are having an adverse impact upon the other. It has become a regular phenomenon. HWCs arise primarily because of competition between

human and wildlife for shared of limited resources. The frequency of conflict has grown in recent years. In Nepal, several study have been carried out on HWC in protected areas where as very few studies have been done on faunal diversity and HWC in CFs, no one can say, how people are tackling with the increasing number of wild animals and is there any loss of fauna or not .

2.0 OBJECTIVES

The general objective of the study was to assess the faunal (mammal) diversity and human wildlife conflict in community forests of Tanahun and Kavrepalanchok districts. The specific objectives were

- To assess the mammal diversity in community forests.
- To assess the status and trend of HWC in community forests during the last six years.
- To explore the methods adopted at community level to reduce conflict.

3.0 MATERIALS AND METHODS

Study area

The study was carried out in Tanahun and Kavrepalanchok districts, mid hills of Nepal (Figure-1). Tanahun district is situated in the western development region of the country. This district lies in between 27° 36' to 28° 5' N latitude and 83° 57' to 84° 34' E longitudes. The total physical area of this district is 154,600 hectares. Its elevation ranges from 187 m above sea level to 2,323 m above sea level. This district has sub-tropical to cool temperate climate. Forest occupies 78,111.22 ha (50.5%) of the total area. 39,447.73 ha of national forest area is managed by 585 user groups in Tanahun district. Benefitted households from community forests are 56,988 (DFO Tanahun, 2071). Similarly, Kavrepalanchok district is situated in the central development region of the country. This district covers an area of 140,486 ha. It is located between 85°24' to 85°49' E to 27°20' to 27°85' N. The climate of the district is sub-tropical to cool temperate. Forest occupies 77,551.74 ha (55.2%) of the total area. 23,952.31 ha of national forest area is managed by 555 user groups in Kavrepalanchok. Benefitted households from community forests are 47,800 (DFO Kavrepalanchok, 2071).

Data collection and analysis

Questionnaire survey, key informant interview and focus group discussion (FGD) were done to collect primary data on mammal diversity and HWC in CFs. The questionnaire survey was used to survey 60 households in both districts (30 HHs in each district). Households from conflict affected areas were selected purposively and face-to-face interviews were conducted with the head of the household. A survey was conducted with 40 key informants including district forest office staffs, school teachers, executives of CFUGs

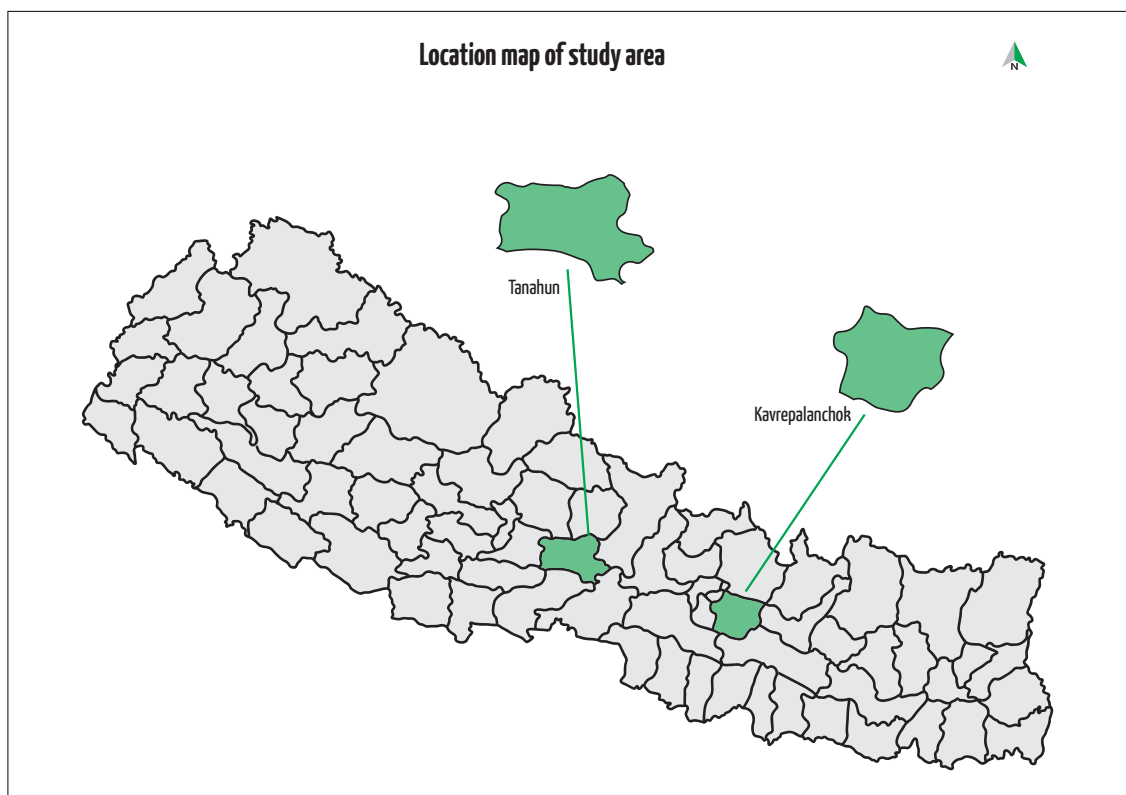


Figure-1: Map showing the study area

and local old persons. Two FGD in Tanahun and one FGD in Kavrepalanchok district were conducted to gather the information on mammal diversity and situation of HWC in community forests as well as the measures adopted at community level to reduce conflict. Local people were actively participated by sharing their knowledge and experiences on mammal incidents and human wild life conflicts in the FGD. It has provided an in-depth understanding of status of HWC, mammal diversity and community response towards wildlife conservation. Data on HWC incidents were collected from the office records of district forest office, Tanahun and Kavrepalanchok, regional forest directorate, community forest user groups. District five year forest management plan of Tanahun and Kavrepalanchok and 60 operational plan of community forests (30 in each district) were also reviewed thoroughly. Published and unpublished literature related to study were also reviewed.

Both quantitative and qualitative techniques were used for analyzing data. Quantitative data were entered in Microsoft Excel and processed to generate information on trend and pattern of HWC. Data were analyzed using simple descriptive statistics in Microsoft Excel.

4.0 RESULTS AND DISCUSSIONS

Faunal (mammal) diversity in community forests

Based on consultation with local communities, review of districts' five year forest management plan, and operational plans of community forests, a total of 15 & 17 mammals were found in CFs of Tanahun and Kavrepalanchok respectively. The major mammal species found in community forests of both districts were: Common leopard (*Panthera pardus*), Barking deer (*Muntiacus muntjac*), Wild boar (*Sus scrofa*), Jungle cat (*Felis chaus*), Jackal (*Canis aureus*), Rhesus monkey (*Rhesus macaque*), Hare (*Lepus nigricollis*), Squirrel (*Funambulus pennati*), Porcupine (*Hystria indica*) and Himalayan Black Bear (*Ursus thibetanus*). Pangolin (*Manis pentadactyla*) was found only in Kavrepalanchok. 100 % of respondents agreed that wild animal has noticeably increased due to establishment of CFs in the areas. They also agreed that CF management has also contributed to development of HWC. Pokharel and Shah (2008) have found 25 mammals in community forests of Satbariya

range post of Dang district. Similarly, they also found that over the 93 % of respondents agreed that wildlife has increased due to establishment of CFs.

Status of HWC in community forests

Higher dependency of local communities on the forests for forest products; closer locations of settlements to the forests; increase in population of wild animals, lack of awareness, fragmented habitat were identified as major causes of HWC in CFs. Human casualty, livestock depredation and crop damage were the major type of HWC in CFs of both districts.

A total of 14 people were killed by leopard in Kavrepalanchok during the last six years (Table-1). Among those who are killed, eight were male and six were female. During the same period, 3 people were injured from leopard in Tanahun. Similarly, 3 people were injured from wild boar in Kavrepalanchok. A total of 28 livestock were predated by leopard (Table-1). Maize and vegetables were damaged by monkey in Tanahun district. A total of 24 wild animals were killed by people in both districts. Among them, 14 were leopards, 4 wild boar and 6 barking deer. Incidents of HWC are shown in Table-1. The result showed that leopard, rhesus monkey, barking deer and wild boar were major species confronting with local community in both Tanahun and Kavrepalanchok. From the 6-year data, leopard is found as the most problematic wild animal in CFs. Bajimaya (2012) found that the incidents of human encounters with common leopard are found to be rise in mountain.

Trend of human casualty

Out of 14 people were killed by leopard during the last six year in Kavrepalanchok, highest human death (n=4) were occurred in fiscal year 2009/2010. The human casualties are occurring irregularly. Trend of human casualty is show in Figure-2 (a). Among those who were killed, 8 people were from ethnic community. Human deaths were occurred in Rabiopi, Debibhuvi baluwa, Khanalthok, Meshinkot, Panchkhal and Patiyachaur VDC of Kavrepalanchok (Figure-2.b). During the same period, 3 people were injured from leopard in Tanahun. Karki and Rawat (2014) reported that a total of 18 humans have been killed during 27 months in seven VDC including 3 injuries in Baitadi district. According to key informant interviews, majority of the attacks took place during evening time in vicinity of the house yards. Common leopards are known to visit the human settlements quite frequently (Athreya *et al.*, 2013) predating on domestic animals and also terrorizing and sometimes injuring or killing the people. Shah *et al.*, (2004) found that on an average, 24 persons have been killed by leopards every year in Nepal during 1994 to 2004.

Trend of retaliatory killing

Out of 24 wild animals were killed by local people during last six year, highest wild animals (n=7) were killed in 2012/2013 and lowest wild animals (n=2) were killed in 2014/15. Trend of leopard killing is shown in figure-3 (a). Out of 14 leopard killed, 5 leopards were killed in fiscal year 2011/2012 and 5 in 2012/2013 respectively. 11 leopards were killed by local people in seven VDC of Tanahun district (Table-3.b).

Table-1: Status of HWC in community forests (FY 2009/10 to 2014/15)

District	Name of wild animal	Human casualty		Crop raiding (kg)	Livestock depredation			Retaliatory killing
		Death	Injury		Goat	Pig	Chicken	
Kavrepalanchok	Leopard	14	-	-	21	5	140	3
	Wild boar	-	3	-	-	-	-	4
	Barking deer							4 (+2 live rescue)
Tanahun	Leopard	-	3	-	2	-	3	11
	Monkey	-	-	4000 (maize, vegetables)	-	-	-	-
	Barking deer	-	-	-	-	-	-	2 (+1 live rescue)
Total		14	6	4000	23	5	143	24

Analysis showed that most of the victims (>60 %) were children below 10 years. Only injured people were mostly above 20 years of age. Karki and Rawat (2014) found a similar result in human leopard conflict in Baidati District of Nepal.

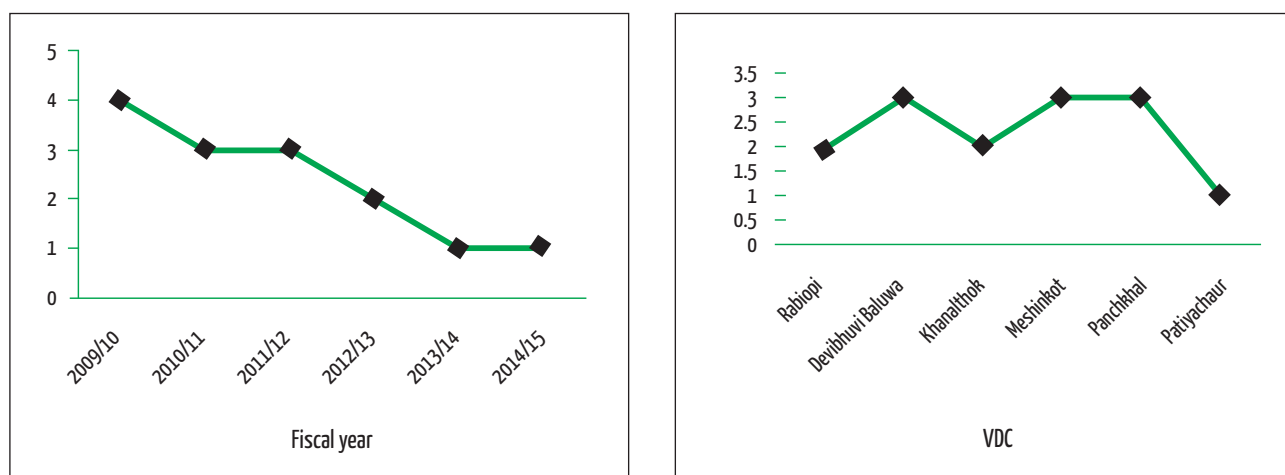


Figure-2: Trend of human death in Kavrepalanchok - (a) Fiscal year wise (b) VDC wise

Measures adopted at community level to reduce conflict

The community forest operational plans do not indicate the issues of HWC. Improvement of wildlife habitat do not find any place in the operational plans. Efforts made by the DFO, Tanahun to minimize the HWC were public awareness programs like cluster level orientation, FM/ radio program, rescue operation, school teaching program and hording board establishment. These programs were very effective to create awareness among community towards wildlife conservation. HWC mitigation networks at district and ilaka level were formed in Tanahun district to minimize the conflict. During the awareness raising program, they basically focused on the issues of biodiversity conservation and ecosystem services, importance of wildlife conservation and utilizing the wildlife damage relief guideline 2069. The government of Nepal has recently revised wildlife damage relief guideline 2069.

5.0 CONCLUSION

With the successful implementation of community forestry in Nepal, degraded forests are restored and rehabilitated and wild animals began to occupy such forests/habitats. Community forests have important role for the development of corridor for free movement of wildlife and conservation of biodiversity. The main theme of community forest is to increase forest cover by providing basic livelihood materials for the local people. Increased forest cover only is not sufficiently fulfilling the necessary habitats for wildlife. So, they used to come outside the forest mainly for searching the food, which can be only fulfilled by conserving each habitats of the forest. Number of wildlife species and population of wild animal has been increased after the establishment of CFs. Human wildlife conflict is also increased in CFs with increased in mammal diversity and their population. Common leopard, monkey, wild boar and barking deer are confronting with

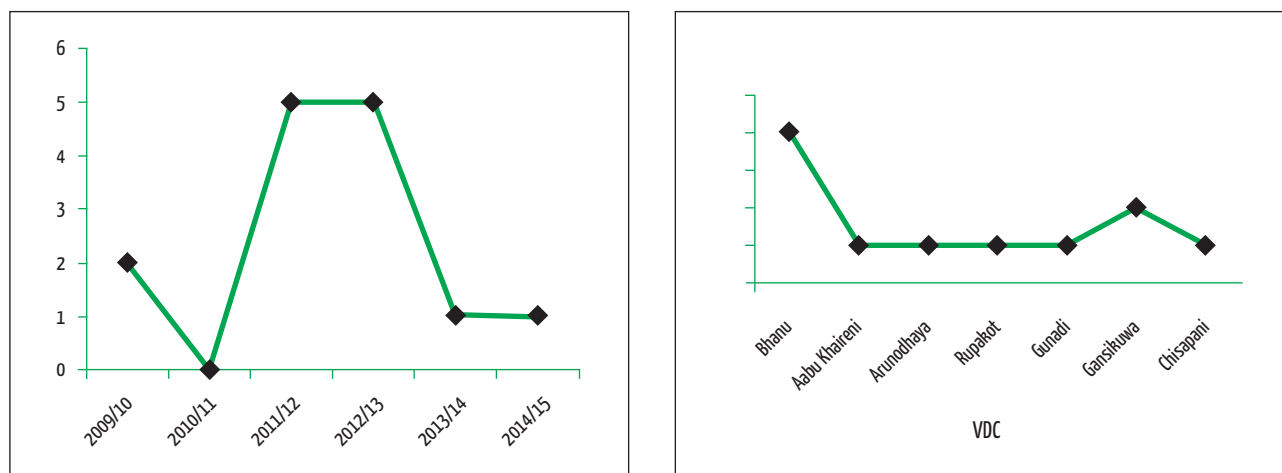


Figure-3. (a): Trend of leopard killed. (b) killing of leopard in Tanahun

local community in both of Tanahun and Kavrepalanchok. Among them, leopard is found as the most problematic wild animal in CFs. The HWC in CFs is becoming a serious threat to the survival of endangered species as well as welfare of local people. Wildlife conservation is beyond the control of one community forest user groups, networking among user groups might be successful for minimizing the HWC.

6.0 RECOMMENDATIONS

- Community forest user groups need more awareness on compensation policy, community forestry development guideline and wildlife management as well as activities that generate benefits at local level.
- Provide instant delivery of compensation or relief to the loss and immediate rescue mechanism.
- Include human wildlife conflict issues in community forest operational plans.
- Establish community based relief fund with sufficient amount and well written fund management guideline.
- Develop strategies for protecting leopards from retaliatory killings.
- Strengthen human wildlife conflict mitigation networks.
- Bundling of community forests is necessary to manage wildlife.
- Incorporate biodiversity conservation procedures in the community forest guideline.

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Overview of Community Forestry Inventory Policy and Plant Biodiversity Management and its Implications

Shyam Prasad Sharma

Abstract

Biodiversity is related to every aspect of people involved in community forestry of Nepal. Importance of biodiversity in agriculture productivity, food security, human health and nutrition, indigenous knowledge, fuel wood, fiber, wood, fodder, grasses, culture, climate, water resources and aesthetic values are linked with community forest management. Till the end of Twelfth Three Years Plan over 18,000 community forest user groups, including over 2.2 million households, have managed about 1.7 million ha of forests as community forests for fulfilling the basic needs of fuel wood, grass, wood and ecosystem services. One of the major principle of community forest management could be the adoption of characteristics of Normal forest in 1.7 million ha community forest area. Community forestry inventory guideline is major policy instrument for overall management of forest. The CF inventory guidelines and practices generally overlook the plant biodiversity, maintenance of vertical plant structure, ecosystems perspectives in CF management. The extensive review of the available documents, CF inventory guidelines, forestry policies and laws paved the way for the analysis of biodiversity perspectives in CF.

Community forestry inventory guideline 2004 and its implications in relation to conversion of community forest towards normal forest, plant diversity, vertical plant structure and overall gaps in community forest management is discussed. The study recommended to incorporate gaps in community forestry inventory guideline policy, 2004 such as balanced diameter distribution of species in forest, fixation of rotation, manipulation of conversion period of forest towards normality, retention of minimum dead fallen trees, categorization of value, use and service of species, adaptation of appropriate Silvicultural Systems, maintenance of plant species diversity, vertical plant structure and adaptation of features of normality of forest in government managed block forest by approach of sustainable forest management principle.

Key words: Normal Forest, Inventory, Community, Diversity

1.0 INTRODUCTION

Biodiversity is related to every aspect of people involved in community forestry of Nepal. Importance of biodiversity in agriculture productivity, food security, human health and nutrition, indigenous knowledge, fuel wood, fiber, wood, fodder, grasses, culture, climate, water resources and aesthetic values are linked with community forest management. The measurement of plant diversity continues to play a central role in ecology and conservation in community forestry.

Till the end of Twelfth Three Years Plan over 18,000 community forest user groups, including over 2.2 million households, have managed about 1.7 million ha of forests as community forests for fulfilling the basic needs of fuel wood, grass, and wood and ecosystem services.

Community forest resource inventory guideline, 2004 is used for preparation of community forestry operational plan by the user of community. The government staff and non-governmental organization plays facilitation in the process of preparation of community forestry operation plan.

Forest resource inventory guideline, 2004 is aimed for sustainable forest management of by assessing seedlings, saplings, pole and tree in a forest. It also focuses analysis of regeneration status, growing stock of forest products, annual increment and yield regulation of timber, fuel wood and pole. After assessment of resource inventory yield is prescribed and plant diversity management is maintained for fulfillment of sustainable forest management goal.

Generally, accepted principle of sustained yield and the classical concept of the normal forest is designed for sustainable forest management. But few questions in

community forest management need to be answered. They are: 1. Are community forests managed sustainably on the principle of normal forest and sustained yield as per community forest resource inventory guideline, 2004? 2. Is inventory guideline sufficiently address plant vertical structure diversity?

2.0 OBJECTIVE

It is aimed to find the gaps in present community forest resource inventory guideline, 2004 and prescribe recommendations in relation to normal forest and maintenance of plant diversity and plant vertical structure in community forest.

3.0 MATERIALS AND METHODS

Extensive literature review and hypothetical assumption of data of normal forest is the main material and method of study. It overviews community forestry inventory guideline, 2004, normal forest principle and other relevant literature.

3.1 Overview of Community Forestry Inventory Guideline, 2004

Guideline focuses in four aspects for management of forest. They are; preparation of forest resource survey, data collection, analysis of data and utilization of data. Data is analyzed and utilized for estimation of growing stock of forest, regeneration status of forest, annual growth rate, and overall status of forest, yield regulation, annual allowable cut estimation and silvicultural activities.

TABLE 1- CLASSIFICATION OF PLANTS AND SIZE OF PLANT IS MEASURED IN SAMPLE PLOT

S.N.	Classification of Plants	Size of plants	Sample size (square meter)	Remarks
1.	Tree	30 cm or more than 30 cm DBH	100-500	DBH is diameter at breast height
2.	Pole	10-29.9 cm DBH	100	
3.	Regeneration			
	a) Saplings	Less than 10 cm diameter and more than 1 m height at DBH	25	
	b) Seedlings	30 cm – 100 cm height	10	
4.	Fuel wood, Grass and litter		100	
5.	Herbal and NTFP plant		10-100	NTFP is Non-timber forest product

3.1.1. Data collection

Forest is divided into different blocks and compartments. Appropriate sampling method, sampling intensity and sampling size is determined in each sample plot size. Classification of plants and size of plant is measured in sample plot as mentioned in Table 1.

3.1.2 Data collection about Biodiversity

Different plants and wild animals in forest are important and useful in context of socioeconomic and forest management point of view. Biodiversity data is collected in interaction with stakeholders and observation in field which are as follows:

- Name of plants and number in Community Forest
- Name of wild animals and number
- Name of Rare plants/animals, place and number
- New species after introduction of community forest
- Important species from social and religious point of view and conservation measures
- Rare plants/animals in block or compartment and conservation measures

3.1.3. Assessment of Regeneration Status of Forest

Regeneration status of Forest in community forest is assessed on the basis of number of seedlings and saplings and is mentioned in Table 2

3.1.4 Estimation of growing stock, status of forest, annual increment of growing stock and annual yield

3.1.4.1 Estimation of Growing stock of timber

Growing stock of timber is estimated on the basis of formula which is as follows:

$$V = \pi d^2 / 4 \times H \times FF \times Q \quad (1)$$

Whereas, V = Volume of timber

d = Diameter at breast height of tree

H = Height of tree

FF = Form factor (0.5 is recommended for all types of tree)

Q = Quality of trees

Quality of tree depends on estimated stem length, good or straight or curved or knot or crooked stem.

Quality of tree is divided into three classes that is first class, second class and third class respectively. If quality of tree is first class, in equation it is multiplied by 2/3, 2nd class multiply by ½ and 3rd class it is not multiplied and whole stem is assumed for use of fuel wood.

3.1.4.2 Estimation of Status of Forest

Estimation of status of forest is determined by regeneration status of forest mentioned in Table 2 and Volume of growing stock estimation from equation 1. Forest status estimation is mentioned in Table 3.

TABLE -2 ASSESSMENT OF REGENERATION STATUS OF FOREST

S.N.	Regeneration Status of Forest			
	Type of Plants	Good	Medium	Poor
1.	Seedlings	More than 5000 number /ha	2000-5000 number /ha	Less than 2000 number /ha
2	Saplings	More than 2000 number /ha	800-2000 number /ha	Less than 800 number /ha

TABLE -3: ESTIMATION OF FOREST STATUS ON THE BASIS OF REGENERATION STATUS AND GROWING STOCK OF FOREST

Total Growing stock of tree and pole	Total Growing stock more than 200 cubic meter/ha			Total growing stock 50-200 cubic meter/ha			Total growing stock less than 50 cubic meter/ha		
Regeneration status	Good	Medium	Poor	Good	Medium	Poor	Good	Medium	Poor
Status of Forest	Good	Good	Medium	Good	Medium	Poor	Medium	Poor	Poor

3.1.4.3. Estimation of Annual increment of Total Growing Stock based on Nature of tree growth and Status of forest

In inventory guideline nature of tree growth of different species is given and it is categorized in three types 1) Fast growing species 2) Medium growing species 3) Slow growing species. The annual increment of species in forest is shown in Table 4.

TABLE 4 -THE ANNUAL INCREMENT OF SPECIES IN FOREST

S.N.	Nature of tree growth	Annual increment rate based on status and total growing status of forest		
		Good	Medium	Poor
1.	Fast growing species	5 %	4%	3%
2.	Medium growing species	4%	3%	2%
3.	Slow growing species	3%	2%	1%

3.1.4.4 Estimation of Annual allowable cut

Principally, if the condition of forest is good, forest products could be removed from the total growing stock at the rate of annual increment of the total growing stock of forest. However, in guideline, certain percentage of annual increment of total growing stock is only removed and it depends on the condition of forest. Community forest user could regulate the yield at the rate of 75 % of annual increment in good forest stocking, 60 % of annual increment in medium forest stocking and 40 % of annual increment in poor stocking forest respectively.

3.2 Review of Normal forest

3.2.1 Normal forest

The normal forest is defined as one having (1) Normal increment (2) Normal age class distribution (3) Normal growing stock. Hypothetical example of Normal growing stock of forest is mentioned in Table 5.

4.0 DISCUSSIONS AND FINDINGS

After review of Community Forest resource inventory guideline, 2004, normal forest and other related literature following findings are extracted from study. Bold highlighted sentences are major findings of study which are as follows;

4.1. Annual yield regulation from normal forest is not imagined in guideline and only average yield is regulated based on total growing stock of timber and annual growth rate.

In Table 5, normal growing stock of forest and normal increment for hypothetical area is assumed. 500 cubic meter/ha/yr. yield could be regulated from forest and it satisfies the characteristics of Normal Forest while in the same area yield regulation based on guideline will be 100 cubic meter/ha (Good forest, estimation based on community forestry inventory guideline, 2004) . It implies that yield regulation based on normal forest condition is 400 cubic meter higher than prescription forwarded in guideline. Similarly, it also shows that less quantity of yield is regulated from community forestry guideline yield

TABLE 5 -HYPOTHETICAL EXAMPLE OF NORMAL GROWING STOCK OF FOREST

S.N.	Age (years)	Area (ha)	Annual increment (cubic meter /ha)	Cumulative increment cubic meter	Total growing stock cubic meter
1	1	1	50	50	50
2	2	2	50	100	100
3	3	3	50	150	150
4	4	4	50	200	200
5	5	5	50	250	250
6	6	6	50	300	300
7	7	7	50	350	350
8	8	8	50	400	400
9	9	9	50	450	450
10	10	10	50	500	500
Total		10 ha	500 cubic meter in 10 years		2750 cubic meter in 10 ha, Average growing stock (275 cubic meter /ha)

prescription method. Hence, the sustained yield principle for sustainable management of forest is not attained from community forestry inventory guideline yield due to low yield regulation from normal forest.

4.2 Guide line is not suitable for different age gradation maintenance in normal forest and hampers the promotion of plant and animal diversity management. Vertical plant structure is not managed.

In self-explanatory figure 1, Normal forest principle could be applied in even aged forest management of community forest. Each year constant flow of yield is regulated and ensures supply in market. In the same way different age gradation and vertical plant structure is maintained for support in pollination, regeneration and animal and plant diversity in community forest.

4.3. Annual yield regulation is function of annual growth and total growing stock of timber and conversion of existing forest towards normality is not defined and prescribed in guideline.

In existing guideline

$$AAC = TGS \times (75\% \text{ or } 60\% \text{ or } 40\%) \times AIP \text{ (Annual Increment percent 5 or 4 or 3 or 2 or 1\%)} \text{ --- (2)}$$

Whereas,

AAC = Annual allowable cut of timber

TGS = Total growing stock

AIP = Annual increment percent

While measuring the growing stock of timber, trees are measured 30 cm or more then cm at diameter breast

Figure 1 Hypothetical normal forest and yield regulation in 10 years species

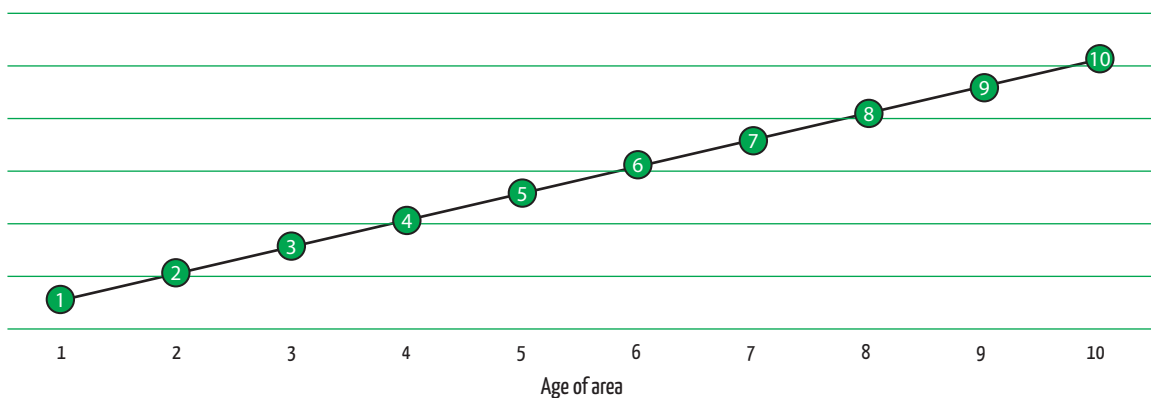
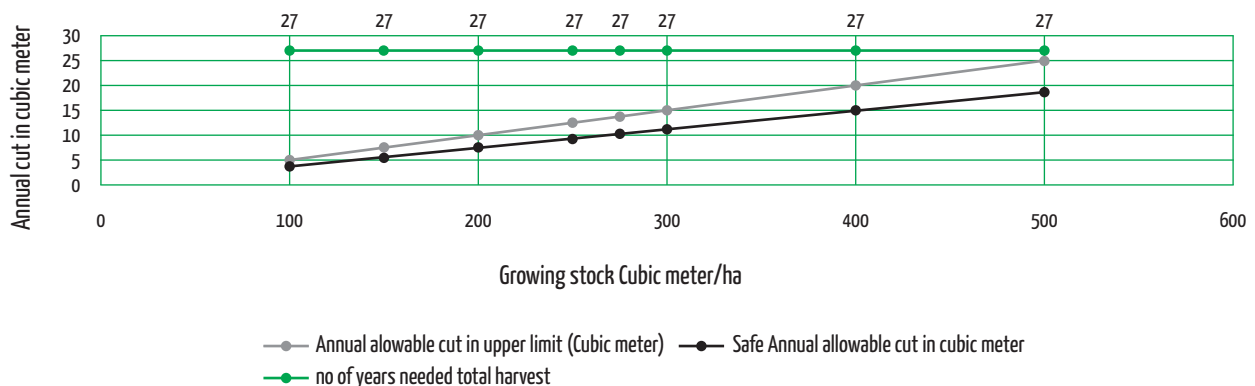


Figure 2 Hypothetical growing stock and AAC from guideline and no of years needed to total harvest



height. In this formula diameter distribution of tree is not considered as factor for yield regulation and if forest is immature or over matured it is not properly regulated by equation 2 and achievement of normality of forest is not discussed. Hence, diameter distribution of trees and yield regulation is interrelated for conversion of forest to normal forest. Normal forest can be achieved by hit and trial method for regulation in forest. Hypothetical data of normal forest is given in figure 1. Growing stock of forest is in Y axis and age or area of forest is in X axis. Total growing stock of forest is 2750 cubic meter in 10 ha area. But yield regulation quantity of such forest as per community forest guideline is maximum 275 cubic meter/yr. Yield regulation from inventory guideline shows undercut of forest and which is neither scientific nor fulfills the characteristics of normal forest. Hence it is necessary to improve yield regulation from inventory guideline formula by maintaining all age class's tree and removal of over matured and old trees in right manner. In figure 2 total growing stock forest is 500 cubic meter /ha of matured and harvestable size volume which is regulated in 27 years @ 18.75 cubic meter which is very less in quantity in context of over matured trees. Due to unscientific regulation of yield, vertical plant structure is not managed and it hampers proper regeneration of species in forest.

4.4 Matured and over matured trees stocking are considered as total growing stock and assumed growth of forest for timber

In inventory guideline, total growing stock of timber is defined as wood volume used for timber in compartment or sub compartment. In the same way, the annual growth rate is defined as annual increment in total growing stock. Theoretically in annual growth of tree, it is small in the seedling stage, becomes progressively greater and, after attaining maximum, falls until it approaches zero or death supervenes. It implies that matured and over matured growth of tree even its growth ceases considered as growing stock or increment of species in policy guideline which is not scientific and need to improve the definition of growing stock.

4.5. Average growth of species is assumed for estimation of yield regulation but growth of each year is not compounded to get real average growth of species

Annual increment is defined as annual increment of seedlings and saplings. Generally growth of tree is defined as multiplication of growing stock and growth percent. Average growth of each species could be calculated on the basis of below given formula.

$$TG = IGS (1+I)^T - IGS \text{ ---- (3)}$$

Where,

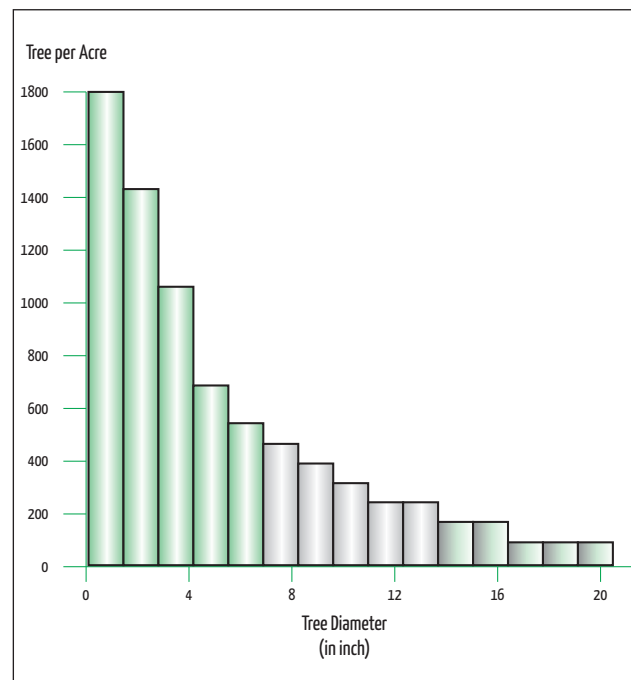
TG	= Total growth after t year
IGS	= Initial growing stock
I	= average annual increment percent
T	= Time of growth in year

The annual growth mentioned in inventory guideline is simply average growth of tree. Hence, Incorporation of above formula for each year growth of species would be better to get exact total growth of tree.

4.6 Trees /ha of different diameter are not considered in CF Management affecting plant diversity

In below given hypothetical figure 3 trees /ha of different diameter are shown. Figure shows higher diameters tree are having less no of trees in comparison to lesser diameter tree. In inventory guideline seedlings, saplings, pole, trees diameter and height are considered for measurement and assessment of growing stock in forest but it does not discuss about regulation of such measurement. So, manipulation in no of trees and diameter per hectare is necessary for maintenance of plant vertical distribution of different diameter and ages in community forest operation plan.

FIGURE 3. TREES DIAMETER PER ACRE AND DIAMETER OF TREE



4.7 Yield regulation is focused only in timber and mixture of other non- timber regulation is not properly addressed.

4.8 Ambiguity in the definition of Growing stock

Growing stock is defined in guideline in two ways such as;

- 1) measurement of standing trees, seedlings and saplings
- 2) for purpose of annual allowable cut estimation growing stock of trees and poles are considered. It created ambiguity in the definition of growing stock.

4.9 Ambiguity in the definition of Annual increment

Annual increment is defined in two ways such as;

- 1) increment of seedlings and saplings
- 2) annual growth rate and annual rate of increment is assumed as fast, slow and medium species (as per annex of guide line). It created ambiguity in the definition of annual increment.

4.10 Value, Current Use and Services of Species is not categorized in guideline

The current use of species by user may be in different aspects such as solid wood products, pulp and paper, energy (fuel), non-wood forest products, agroforestry systems, fruit, ply wood and others. In the same way, services and value of species may be for soil and water conservation, soil fertility, biodiversity conservation, cultural values, aesthetic values, watershed management, religious value and others. Use, value and services are important factor in decision making for regulation of plant diversity in community forestry.

5.0 REVIEW OF GOVERNMENT MANAGED DHANSAR BLOCK FOREST MANAGEMENT PLAN OF RAUTAHAT, DISTRICT AND FINDINGS

Dhansar block forest management was prepared in fiscal year 2071-72 and area of block forest is 1052.92 ha. Forest type is Sal Terai Hardwood Forest, Sal Forest and Terai Hardwood. Forest is divided into three compartments and each compartment is divided into eight sub compartment. Each Sub compartment is divided into ten working units. In each sub compartment, regeneration establishment period is 10 years. In each year, active forest management is proposed in 11.801 ha. In 70-80 years whole forest will be actively managed. Forest will be converted to Normal forest after 70 -80 years.

In Silviculture system, irregular system is adopted. The major objective of plan is to maintain 70-80 % Sal Forest (*Shorea robusta*) and 20-30 % of other species in forest. Matured, over matured, fallen trees due to wind and hurricane is fully utilized. Number of trees, diameter class distribution and volume is maintained. Regeneration felling, preparatory felling, regeneration enrichment, enrichment of growth of stand, thinning, cleaning, dead and dying trees are silviculture activities. Proportionate no of each species , development class such as seedlings ,saplings, pole and tree, basal area, height-diameter class, growing stock based on dead, dying, diseased, decaying and good quality tree, average annual increment, stem mapping of harvestable tree and use of geographical positioning system for area calculation are variables used in plan preparation.

Retention of 15-25 good seed trees /ha in regeneration felling, maintenance of 130-150 trees for preparatory felling, retention of pole 400-500 after thinning and pruning , maintenance of 1600-2000 /ha saplings , removal of trees more than 40 cm diameter for maintenance of saplings , removal of debris after felling, maintenance and management of coppice in case of fallen tree, pole and saplings, enrichment of regeneration support activities such as seed sowing, soil work, removal of leaf and litter, weeding and maintenance, removal of dead, dying and fallen trees are detail activities of Silviculture. In protection of forest, fire line construction and maintenance and regeneration protection forest watchman and bio fencing are prescribed.

Biodiversity is also maintained leaving one fallen or dead tree/ha. After implementation of 10 years 1600-2000 saplings/ha, 800-1200 pole/ha and 400-500 pole or tree will be converted to 800-1200 pole/ha, 400-500 pole or tree/ha and 130-150 pole or tree/ha respectively.

Total growing stock of forest is 1, 71,040.05 cubic meter and average growing stock of forest is 170.92 cubic meter /ha. Regeneration status of seedlings and saplings of Sal and other species are 1139, 492 and 3382 and 750/ha respectively. Average increment of forest is 3.25 cubic meter/ha.

Annual yield forecasting from regeneration felling area, dead, dying collection and thinning is 40,573 cft. In estimation of yield it might decrease or increase and depends on prescription of plan. Yield is prescribed in flexible way. Flexibility in yield regulation is good aspect in government managed block forest than community forest.

After review of government managed block forest, following findings are extracted:

- Trees and diameter class are maintained in government managed block forest whereas it is not practiced in community forest and it shows that there is no uniformity in practice of same government forest.
- Per ha volume and diameter class are maintained in

government managed block forest whereas it is not practiced in community forest and it also shows there is no uniformity in practice in community forest and block forest.

- Mixture of species and no / unit area are not distinctly defined and considered in guideline, however in block forest it is practiced.
- One fallen tree/ha is retained in block forest where as it is not mentioned in guideline of community forestry for promotion of biodiversity.
- Irregular shelter wood and coppice system is recommended in block forest whereas no silvicultural system is designed in community forestry guideline.

6.0 RECOMMENDATIONS

Based on extracted findings from the study, following major recommendations are made in community forestry guideline, 2004 and improvement in community forest operation plan for maintenance of plant diversity and vertical structure of plant.

6.1 General recommendation

- Comprehensive review in 2004 CF guideline is required

6.2 Specific recommendations

- Under stocked, normal stocked and overstocked forest of required species will be manipulated towards normality of forest by adopting scientific forest management system.
- Use , value and services of each species will be described in community forest operation plan
- At least 1 fallen or dead tree/ha of each species will be retained in community forest for maintenance of biodiversity.
- Appropriate choice of silvicultural systems such as tree seed, shelter wood, clear felling, selection and other will be mentioned in guideline of community forestry.

7.0 CONCLUSION

Incorporation of sustained yield, normal forest principle, and conversion of forest towards normality and comprehensive review of community forestry resource survey guideline, 2004 are imperative to fulfill the objective of sustainable forest management, maintenance of plant diversity and maintenance of vertical plant structure in 18,000 community forest user groups.

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जैविक विविधता संरक्षण, मानव वन्यजन्तु द्वन्द्व व्यवस्थापन सँगै सम्बृद्धिका लागि सामुदायिक वनः स्थलगत सवाल तथा नीतिगत चुनौतिहरू

प्रकाश लम्साल

सारांश

जैविक विविधता संरक्षण र आर्थिक विकासका लागि वनजन्य श्रोतको व्यवसायिक उपयोग गर्ने कार्य जहिले पनि चुनौतिले भरिएको हुन्छ। नेपालको सामुदायिक वन विकास अपवाद हुन सक्दैन। जिल्ला वन कार्यालय तथा संलग्न सामुदायिक वन उपभोक्ता समूहको सार्थक सहभागिता र साभेदारी मार्फत सहभागितामूलक संरक्षण तथा व्यवस्थापनमा नेपालले उल्लेख्य प्रगति हासिल गरी राष्ट्रिय तथा अन्तराष्ट्रिय स्तरमा ख्याति समेत पाएको मानिन्छ। सहभागी सावउस तथा सहयोगी निकायको काम, कर्तव्य तथा जिम्मेवारी पनि नीतिगत, कानूनी तथा कार्यक्रमिक रूपमै तोकिएको अवस्था छ। कार्यक्रम प्रगतिउन्मुख हुँदै गर्दा नीतिगत परिकल्पनामा नभएका तर अत्यन्तै स्वाभाविक नयाँ पुस्ताका सवालहरू देखिन थालेका छन्। एउटा मात्र समूहको कार्यक्षेत्रभित्र अटाउन नसक्ने तर अपरिहार्य बनेका सामुदायिक वनमा वन्यजन्तु तथा जैविक मार्ग संरक्षण, नदी तटीय/जलाधार क्षेत्र संरक्षण, विहंगम भू-परिधिस्तरमा संरक्षण समन्वय, रेड (REDD) कार्यान्वयन तथा जलवायु परिवर्तन अनुकूलन जस्ता कार्य ठूलो चुनौतिको रूपमा आएका छन्। यस्ता कार्यहरू दुई वा दुईभन्दा बढी सावउसबीच कार्यमूलक साभेदारी तथा सहकार्य बिना सम्भव छैन। संरक्षणमा यस किसिमको सहकार्यले अन्य थप अवसरको ढोका समेत खुलाउने अनुभवले देखाएको छ। छरिएर रहेका सावउसको स्रोत एकिकृत गरी उच्च विकास तथा रोजगारी सिर्जनामा लगानी र भू-परिधिस्तरमा संरक्षण तथा सामाजिक विकास जस्ता कार्यहरू समेत गर्न सकिने छ। हाम्रा नीति तथा कार्यक्रमले यस किसिमको बृहत साभेदारी तथा सहकार्यको परिकल्पना नै नगरेका हुँदा टड्कारो आवश्यकताका बावजुद उल्लेखित सवालहरूलाई स्थलगत रूपमा यथोचित सम्बोधन गर्न सकिएको छैन। यस्ता सवालहरूलाई सम्बोधन गरेर मात्र सही मानेमा हाम्रो वन क्षेत्रलाई सम्बृद्ध र संरक्षित बनाउन सकिन्छ।

प्रस्तुत कार्यपत्रमा यस किसिमको साभेदारी कसरी गर्न सकिन्छ ? यसले मानव वन्यजन्तु द्वन्द्व व्यवस्थापन गरी जैविक विविधता संरक्षण गर्न कसरी सहयोग पुऱ्याउँछ ? जलवायु परिवर्तन अनुकूलन तथा रेड कार्यान्वयनमा कसरी मद्दत पुऱ्याउँछ ? सम्बृद्धिका लागि वन भन्ने नेपाल सरकारको नीतिलाई व्यवहारिक रूपमा कार्यान्वयन गर्न यस प्रकारको साभेदारीले कसरी सहयोग पुऱ्याउँछ ? उल्लेखित मुद्दाहरूको विवेचना गरी वर्तमान सामुदायिक वन सम्बन्धी नीति तथा कार्यक्रममा गर्नुपर्ने परिवर्तनका क्षेत्रहरूको पहिचान गरिएको छ र परिवर्तन संस्थागत गर्ने तरिका उल्लेख गरिएको छ।

मुख्य शब्दहरू: सामुदायिक वन, जैविक विविधता र द्वन्द्व व्यवस्थापन

१.० पृष्ठभूमि

वन स्रोत जैविक विविधताको भण्डारका साथसाथै निर्माण र उपभोग्य सामग्रीको भण्डार तथा उत्पादन स्थल पनि हो। हामी विकासोन्मुख मुलुक भएकाले उपभोग्य सामग्रीको लागि वन क्षेत्रमा अत्याधिक चाप त पर्छ नै। जैविक विविधता संरक्षण र पारिस्थिकीय सेवाको दिगो प्रवाह पनि उत्तिकै अनिवार्य भएको छ। तसर्थ सन्तुलित रूपमा जैविक विविधता संरक्षण र आर्थिक विकासका लागि वनजन्य स्रोतको व्यवसायिक उपयोग गर्ने कार्य जहिले पनि टकरावपूर्ण र चुनौतिले भरिएको हुन्छ। नेपालको वन क्षेत्र यसमा अपवाद हुन सक्दैन।

जनमुखी तथा सहभागितामूलक कार्यक्रम मार्फत दिगो वन व्यवस्थापन र जैविक विविधता संरक्षण कार्यमा नेपालले लामो अनुभव हासिल गरेको छ। वन ऐन २०४९, राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन २०२९ एवं सम्बन्धित नियमावलीहरूले वन व्यवस्थापन पद्धतिको आधारमा वन क्षेत्रको स्पष्ट विभाजन गरेर संलग्न सरोकारवालाहरूको भूमिकालाई समेत स्पष्ट बनाएका छन्। नेपाल सरकारले वन क्षेत्रमा सामुदायिक वन विकास कार्यक्रम, कबुलियती वन विकास कार्यक्रम, साभेदारी वन व्यवस्थापन, निकुञ्ज तथा आरक्ष वरीपरी मध्यवर्ती क्षेत्र विकास जस्ता कार्यक्रम मार्फत वन व्यवस्थापन तथा जैविक विविधता संरक्षणमा जनसहभागिता जुटाउने कार्यलाई मूर्त रूप दिँदै आइरहेको छ। यसैगरी धार्मिक वन, निजी र सार्वजनिक जग्गामा वन व्यवस्थापन कार्य समेत स्थलगत कार्यान्वयनमा छन्। प्राप्त परिणामहरूका आधारमा नेपालको अधिकारमुखी तथा सहभागितामूलक वन व्यवस्थापन प्रणालीले राष्ट्रिय र अन्तर्राष्ट्रियस्तरमा ख्याति समेत आर्जन गरेको मानिन्छ। नेपाल सरकारले वन तथा जैविक विविधता संरक्षण कार्यलाई सहभागितामूलक र जनमुखी बनाउने प्रयास मात्रै गरेको छैन यस कार्यलाई अगाडि बढाउन अन्तर्राष्ट्रिय भूमिका समेत खेप्दै आइरहेको छ। जसरी नेपाल जैविक विविधतामा सम्बृद्ध छ यसरी नै व्यवस्थापनका पद्धति, कार्यान्वयनका अनुभव र सिकाइहरूमा पनि विविधता देखिएको छ।

नेपालमा हालसम्म १८,००० भन्दा बढी सामुदायिक वन (साव) हरू स्थापना भै त्यतिनै संख्यामा सामुदायिक वन उपभोक्ता समूह (सावउस) हरू करिब १७ लाख हेक्टर भन्दा बढी वन व्यवस्थापन कार्यमा संलग्न छन् (वन विभाग २०७१)। उठान गर्न लागिएको सवाल तथा मुद्दाहरूलाई अधिक स्पष्ट पार्नका लागि यस आलेखमा सामुदायिक वनको कार्यान्वयन पक्षमा मात्र ध्यान केन्द्रित गरिएको छ। कार्यान्वयनमा हालसम्म देखिएका विभिन्न पक्षहरूको पहिचान तथा विश्लेषण, नविन अनुभव तथा सिकाइहरू र तिनीहरूलाई संस्थागत गर्ने तरिका र प्राप्त हुन सक्ने अवसरहरूबारे उल्लेख गर्ने प्रयास गरिएको छ।

२.० उद्देश्य

विगत दुई दशक भन्दा लामो समयसम्म सामुदायिक वन विकास कार्यक्रम कार्यान्वयनमा छ। यस विच सामुदायिक वन प्रकृत्यामा नयाँ-नयाँ सवालहरू देखा परेका छन्। नयाँ किसिमका समस्याहरू आएका छन्। सामुदायिक वन नितान्त गतिशील प्रकृत्या भएको र नयाँ मुद्दाहरूलाई सम्बोधन गर्दै अगाडी बढ्नुपर्ने आवश्यकताको पृष्ठभूमिमा यस आलेखका मुख्य दुई उद्देश्यहरू रहेका छन्।

- १) वर्तमान सामुदायिक वन नीति तथा कार्यक्रमको संक्षिप्त विश्लेषण र रिक्तताहरू पहिचान गर्दै तत्काल नीतिगत तथा कार्यक्रमिक सम्बोधन गर्नेपर्ने सवालहरूलाई सरोकारवाला पाठक समक्ष पुर्‍याउने,
- २) नविन सवालहरूलाई नीतिगत सम्बोधन गर्नका लागि वातावरण सिर्जना गर्न सरोकारवाला विच आवश्यक छलफल, बहस चलाउने।

३.० तरिका

निम्न तरिका प्रयोग गरेर यो आलेख तयार पारिएको छ :

- विद्यमान नीति तथा कार्यक्रमहरू र कार्यान्वयन स्थितिको अध्ययन
 - वन ऐन २०४९ र वन नियमावली २०५१
 - वन क्षेत्रको नीति २०७१
 - सामुदायिक वन विकास कार्यक्रमको मार्गदर्शन २०६५
 - वन विभागका स्वीकृत वार्षिक कार्यक्रम तथा प्रगति विवरणहरू
- वन सेवाको स्थलगत देखि नीतिगत तहसम्मका निकायमा रहेर काम गरेको लामो अनुभवको उपयोग
- तराई भू-परिधि कार्यक्रम अन्तरगतका जिल्ला वन कार्यालयहरू रौटहट, पर्सा, बारा, मकवानपुर, चितवन, नवलपरासी, पाल्पा, अर्घाखाँची, कपिलवस्तु, दाङ, बाँके, बर्दिया, कैलाली, कञ्चनपुरका वार्षिक प्रतिवेदन तथा जिल्ला वन अधिकृतसँगको व्यक्तिगत संचार र स्थलगत अवलोकनका साथै स्थानीय समूहहरू सँगको छलफल।

४.० नतिजा र बहस

४.१ सामुदायिक वन (साव) व्यवस्थापनको विद्यमान सोच तथा नविन अनुभव

वन ऐन २०४९, वन नियमावली २०५१ तथा सामुदायिक वन विकास कार्यक्रमको मार्गदर्शन २०६५ बमोजिम साव तथा सावउसः

- सामुदायिक वन भन्नाले सामूहिक हितको लागि वनको विकास, संरक्षण र उपयोग गर्न ऐनको दफा २५ बमोजिम उपभोक्ता समूहलाई सुम्पिएको राष्ट्रिय वन सम्झनु पर्छ (वन ऐन २०४९, दफा २)।
- उपभोक्ता समूह भन्नाले सामुदायिक वनको व्यवस्थापन तथा उपयोग गर्न ऐनको दफा ४२ बमोजिम दर्ता भएको उपभोक्ता समूह सम्झनु पर्छ (वन ऐन २०४९, दफा २)।
- कार्ययोजना बमोजिम वनको विकास संरक्षण, उपयोग, व्यवस्थापन गर्न तथा स्वतन्त्र रूपले वन पैदावारको मूल्य निर्धारण गरी बिक्री वितरण गर्न पाउने गरी जिल्ला वन अधिकृतले तोकिए बमोजिम उपभोक्ता समूहलाई साव सुम्पन सक्ने (वन ऐन २०४९ दफा २५)
- सामूहिक हितका लागि कुनै वनको विकास र संरक्षण गर्न तथा वन पैदावारको उपयोग गर्न चाहने त्यस्तो वनको सम्बन्धित उपभोक्ताहरूले तोकिए बमोजिम उपभोक्ता समूह गठन गर्न सक्नेछन् (दफा ४१), समूह दर्ताभै प्रमाणपत्र पाएपछि (दफा ४२) उपभोक्ता समूह संगठित संस्था हुने (दफा ४३)।
- वनको नक्सा सहितको विवरण, व्यवस्थापनका उद्देश्य तथा तरिकाहरू, वन सम्बर्धन तथा विकासका कार्यहरू, बिक्री वितरण तथा आमदानीको उपयोग, वन्यजन्तुको संरक्षण लगायतका कुराहरू समावेश भएको कार्ययोजना (वन नियमावली २०५१, नियम २८) र समूहको नाम, ठेगाना, उद्देश्य, सदस्यहरूको सूची, समूह तथा समितिको काम कर्तव्य तथा अधिकार जस्ता कुराहरू स्पष्ट पारिएको विधान (वन नियमावली २०५१, नियम २७ र अनुसूची ११) हुने।

यसरी स्पष्ट रूपमा परिभाषित तथा संस्थागत हुने कानूनी व्यवस्था गरिएको साव प्रकृत्यालाई अरु बढी सुदृढ गर्न नेपाल सरकार, वन विभागद्वारा सामुदायिक वन कार्यक्रमको मार्गदर्शन जारी गरी कार्यान्वयनमा ल्याइएको छ। यसलाई समयानुकूल परिवर्तन गरी स्थलगत अनुभवलाई समेट्ने प्रयास समेत गरेको छ (मार्गदर्शन २०६५, २०७१)। सावको कार्यान्वयनले द्रुत गति लिनै जाँदा लाखौं हेक्टर क्षतिग्रस्त राष्ट्रिय वन सामुदायिक वनको रूपमा पुनरस्थापना तथा व्यवस्थापन भएका छन्। करिब १८ लाख हेक्टर वन क्षेत्र सावउसको निर्णायक सहभागितामा व्यवस्थापन हुनु साव कार्यान्वयनको दुई दशकको उल्लेखनीय उपलब्धी नै हो।

साव कार्यान्वयनको सुरुआती दिनमा यस क्षेत्रको चिन्ता र सरोकार बढ्दो वन विनास र क्षयीकरण नै थियो। सुरुआती प्रथम पुस्ताका सरोकारका विषयलाई सम्बोधन गर्न बनेका नीतिगत तथा कार्यक्रमिक व्यवस्था सफल भएर नै यो अवस्थामा आएको मान्नु पर्दछ। यस बिन्दुमा आउँदा एउटा महत्वपूर्ण सवाल भने उल्लेख गर्नुनै पर्दछ। वन ऐन २०४९, नियमावली २०५१, कार्यान्वयन मार्गदर्शन २०६५ लगायतका नीतिगत तथा कानूनी दस्तावेजहरूले प्रत्येक सावको छुट्टा-छुट्टै तथा एकल अस्तित्व मात्र देखेका तथा परिकल्पना गरेका छन्। सोहि अनुसार उनीहरूको काम कर्तव्य तथा अधिकार व्यवस्थित गरिएको छ। सहयोगी निकायको रूपमा जिल्ला वन कार्यालयको भूमिका पनि त्यसरी नै व्यवस्थित गरिएको छ। सावउस तथा सावको सम्पूर्ण कृयाकलाप तथा अस्तित्व स्वीकृत कार्ययोजना तथा विधानको सिमाभित्र मात्र कायम हुन्छ र भैराखेको पनि छ।

४.२ नविन अनुभव: केही सवाल, समस्या तथा चुनौतिहरू

सामुदायिक विकास र वन संरक्षण/व्यवस्थापन स्वयंमा अत्यन्तै गतिशील प्रकृत्या हुन। जिल्ला वन कार्यालयको सहकार्यमा सावउसको माध्यमबाट व्यवस्थापन हुँदा गतिशीलता अरु थपिएको छ। परिवर्तनका क्षेत्रहरू नविन एवं बहुआयामिक देखिएका छन्। सावको हालसम्मको प्रगतिले केही अत्यन्तै नविन तथा विशिष्ट सोच, सरोकारका विषय



तथा मुद्दाहरू ल्याएको छ। साव र यसको भूमिकालाई अझ बढी सम्बृद्ध, गतिशिल तथा जनमैत्री बनाउँदै निम्नलिखित सरोकारका विषयलाई कसरी सम्बोधन गर्न सकिनेछ ?

- साव मार्फत वन क्षेत्र पुनरस्थापित हुँदै गर्दा वन्यजन्तु पनि पुनरस्थापित भएका छन्। वन्यजन्तु व्यवस्थापनलाई साव र सावउसको कार्ययोजना र विधानको सिमाभित्र सिमित गर्न सकिन्छ। वास्तविक संरक्षणको लागि वन, वन्यजन्तु र समुदाय सबै संरक्षित हुनु पर्दछ। निर्धारित उद्देश्य पुरा गर्न साव संरक्षण सँगै सदा चलायमान वन्यजन्तुको वासस्थान तथा जैविक मार्ग संरक्षण कसरी गर्न सकिनेछ ?
- मानव वन्यजन्तु द्वन्द्व ठूला पत्रिकाका अग्रपृष्ठका आकर्षण बनेका छन् (धुवे हात्ती, बैतडीको नरभक्षी चितुवा, भूपामा हात्ती वितण्डा, बर्दिया तथा कैलालीको धनजनको क्षति तथा प्रतिशोधमा वन्यजन्तुको हत्या जस्ता कैयौं उदाहारण)। द्वन्द्वमा परेका वन्य जनावर तथा मानिस दुवै पराजित भएको अवस्था छ। ठूलो territory and travel भएका जनावरको सास्ती पिडित परिवारले मात्र भोगेको अवस्था छ। नेपाल सरकारले बाघको संख्या दोब्बर बनाउने लक्ष्य राखेको छ। अब द्वन्द्व दोब्बर भन्दा बढी नहोला भन्न सकिन्छ। यसको व्यवस्थापनमा साव र सावउसको एकल तथा टुक्रे भूमिकाबाट सम्भव होला ?
- खोलाको उप-जलाधारलाई आधार मानी एकिकृत संरक्षण तथा विकासबाट मात्र चुरे संरक्षण हुन्छ भन्ने अनुभवले देखाएको छ। विभागीय मार्गदर्शन पनि यसै प्रकारको छ। एक उप-जलाधारमा कैयौं साव हुन सक्दछन्। तल्लो र माथिल्लो तटीय समुदाय हुन सक्दछ। पानी, खोला तथा जलाधार संरक्षणमा सावको एकल भूमिका कस्तो होला ? के यो प्रयाप्त हुन्छ ?
- अधिकांस पहाडी र चुरे क्षेत्रमा प्रकोपका घटना तल्लो तटीय क्षेत्रमा र प्रकोपजन्य कारक तत्वहरू उपल्लो तटीय क्षेत्रमा देखिन्छन्। वास्तविक रूपमा प्रकोप नियन्त्रणको लागि उपल्लो र तल्लो तटीय क्षेत्रको अन्तरसम्बन्ध अपरिहार्य देखिएको छ। यो अन्तरसम्बन्ध कसरी स्थापना तथा सुदृढ गर्न सकिनेछ ?
- नेपालमा रेड कार्यान्वयन तयारी स्वरूप समुदाय तथा जिल्ला वन कार्यालयको क्षमता अभिवृद्धि, वन विनाश तथा क्षयीकरणका कारक तत्व पहिचान तथा सम्बोधन कार्यक्रम अभियानको रूपमा चालु छ। यो कार्यक्रम लिएर हजारौं सावउससँग छुट्टा-छुट्टै जान सकिनेछ ?

खास गरी सामुदायिक वन कार्यान्वयनका कतिपय नविन उपलब्धी, सिकाइ, आवश्यकता तथा सरोकारका विषयहरू वन क्षेत्रका नीति तथा कार्यक्रमहरूको विद्यमान घेराभन्दा अझै फराकिला (broader than anticipated coverage) हुँदै गएका छन्। वन्यजन्तु तथा जैविक मार्ग संरक्षण, नदी तटीय/जलाधार क्षेत्र संरक्षण, विहंगम भू-परिधिस्तरमा

संरक्षण समन्वय, रेड (REDD) कार्यान्वयन तथा जलवायु परिवर्तन अनुकुलन जस्ता कार्यहरू एउटा मात्र समूहको कार्यक्षेत्रभित्र अटाउनै सक्दैनन्। यस्ता कार्यहरू दुई वा दुईभन्दा बढी सावउसबीच कार्यमूलक साझेदारी तथा सहकार्य बिना सम्भव होला ?

४.३ विद्यमान नीति, कार्यविधि तथा कार्यक्रमले नदेखेको विषय

माथि उठाइएका सवाल तथा सरोकारका विषयहरू प्रतिनिधि मात्र हुन। उल्लेखित सवालहरू एक सावउस र साव कार्ययोजनाको वैधानिक कार्यक्षेत्रभित्र अटाउन सक्दैनन्। कुनैपनि सामुदायिक वनको अस्तित्व निरपेक्ष हुनै सक्दैन। भू-परिधिका अन्य भू-श्रोत र सामुदायिक वनको अस्तित्वसँग सापेक्षित हुन्छ। अर्को अर्थमा भन्ने हो भने कुनैपनि सावको एकल अस्तित्वको परिकल्पना अव्यवहारिक हुन्छ। प्रत्यक्ष उपभोग्य वन पैदावारको लागि वन व्यवस्थापन गर्न सावउस तथा सावको एकल अस्तित्व भएता पनि उल्लेखित सवालको



सेरोफेरो र व्यवहारिक रूपमा भने नजिकका सावउस तथा सावहरू एक आपसमा अन्तरसम्बन्धित (interrelated) छन्। उनीहरूको सह-अस्तित्वमा मात्र प्रत्येक साव/सावउसको एकल अस्तित्व कायम हुन सक्दछ। उल्लेखित सवालहरूले स्वाभाविक रूपमा दुई वा दुईभन्दा बढी सावउसको कार्यमूलक (functional) साभेदारी तथा सहकार्यको माग गरेका छन्। यहि कुरा हो विद्यमान नीति, नियम, मार्गदर्शन तथा कार्यविधिले निर्माणको बेलामा नदेखेको वा देख्न नसकेको। स्थापित सावउसको काम स्वाभाविक रूपमा आफ्नो कार्यक्षेत्रभित्र मात्र सिमित भएको फलस्वरूप साव र सावउसहरूमा निम्न किसिमका संकेत/लक्षणहरू देखा परेका छन्।

- वन पैदावार समुदायको, वन्यजन्तु तथा तीनको वासस्थान संरक्षण गर्ने जिम्मेवारी सरकारको मात्र भन्ने धारणाको विकास भएको छ। सरकारले राष्ट्रिय वन क्षेत्रलाई सावको रूपमा हस्तान्तरण गर्दै गएको तर मानव वन्यजन्तु द्वन्द्वको स्थितिमा जिल्ला वन कार्यालयले उनै समूहको तातो रिस र वन्य जनावरले प्रतिशोधको सामना गर्नु परेको छ, जसले गर्दा समुदाय, वन तथा वन्य जनावर सबैको पराजय भएको स्थिति छ।
- सावको उद्देश्य नै कतै साँघुरो त हैन ? जसको प्रमुख उद्देश्य नै समुदायलाई वन पैदावार उपलब्ध गराउने हो, जुन अवधारणा वैज्ञानिक वन व्यवस्थापन (Scientific forestry) सँग मेल खान्छ ? (हेर्नुहोस्: Wilson G. A. and Bryant R. L. 1997. Environmental Management: New Directions for the Twenty-First Century. UCL Press).
- हिंस्रक वन्यजन्तुको उद्धार र व्यवस्थापन, खोला, नदी तलाउमा विषादी प्रयोग गरी माछा मार्ने प्रवृत्ति प्रति सावहरू उदासिन देखिएको अवस्था छ। सहयोगी कर्मचारीहरू समेत उपयुक्त कार्यक्रमको अभावमा के गर्ने के नगर्ने भ्रममा देखिन्छन्।
- वन्यजन्तु र तीनको वासस्थान संरक्षणको परिकल्पनाको अभावमा अधिकांश सावको गन्तव्य निरपेक्ष तथा मृत वन (dead and fragmented forest syndrome) तर्फ उन्मुख भएको अवस्था छ। गन्तव्य सम्बृद्ध वन सम्बृद्ध जीवन आत्मसाथ हुन नसक्दा विविध प्रकारका विसंगतिहरू देखा परेका छन्।
- सावउसहरू निरपेक्ष तथा एकल शैलीमा अधि बढ्दा उनीहरूमा अनुत्तरदायी तथा अन्तरमुखी स्वभावको विकास (विक्री हुने पैदावार मात्र सकलनमा प्राथमिकता, वनमा न्यून लगानी आदि) भएको र यसले समूहको सुशासन र वन प्रणालीमा प्रतिकुल प्रभाव पारेको देखिएको छ।
- अधिकांश सावउसहरूमा आर्थिक श्रोत साधन भएता पनि नजिकका सावउसको सहकार्यको अभावमा उपलब्ध श्रोतको उचित लगानी हुन नसकेको अवस्था, यस्ता श्रोत एकिकृत गरी आय-आर्जन, उद्यम तथा अन्य सम्बृद्धिका कार्यहरू गर्न सकिने अवसरबाट विमुख हुन परेको अवस्था।

- चुरेस्थित खोलाका जलाधार संरक्षणको लागि तल्लो र उपल्लो तटीय सम्बन्ध सैद्धान्तिक विषय मात्र बनेको छ। वास्तविक सम्बन्ध संस्थागत (linkage) को स्थापना गरी संरक्षणको लागि समन्वय हुन सकेको छैन।

४.४ चुनौतिको सामना गर्ने नवीन उपाय

नयाँ पुस्ताका सवाल तथा समस्याहरूको सम्बोधन नयाँ ढङ्गको नीतिगत तथा कार्यक्रमिक उपायले मात्र गर्न सकिन्छ। तसर्थ उल्लेखित सवाल तथा समस्याहरू तत्काल रणनीतिक सम्बोधनको पर्खाइमा छन्। वन विभागकै मध्यस्थता (intervention) मा केही सकारात्मक तथा उत्साहप्रद पहलहरू पनि भएका छन्। तराई भू-परिधि कार्यक्रमको सहजीकरण तथा सहयोगमा तराई तथा चुरे क्षेत्रका जैविक मार्गहरूमा उस्तै समस्या तथा आवश्यकता भएका सावउसहरू संस्थागत रूपमा साव समन्वय समितिमा (सावसस) संगठित भएका छन्। सावससहरूले जैविक मार्गस्तरमा सहभागि साव/सावउसको एकल अस्तित्व, अधिकार, कर्तव्य तथा कार्यक्रमलाई सुदृढ गर्दै माथि उल्लेखित सरोकारका विषयहरूमा संयुक्त रूपमा कार्यक्रम संचालनमा संलग्न छन्। सावउसहरूको संस्थागत साभेदारी तथा सहकार्यबाट विहंगम भू-परिधिस्तरमा निम्न किसिमका संरक्षण र विकासका कामहरू भएका छन् (स्रोत: तराई भू-परिधि कार्यक्रम-वन विभाग)।

- प्रभाव क्षेत्रका सावउसहरू जलाधार/जैविक मार्ग तथा आवश्यकता अनुसार विहंगम भू-परिधिस्तरमा सामुदायिक वन समन्वय समिति (सावसस) मा संस्थागत रूपमा आवद्ध भै वृहतस्तरमा एकिकृत संरक्षण, सामुदायिक विकास तथा जीविकोपार्जन कार्यक्रम संचालन भएका।
- संकटमा परेका प्रजाति संरक्षण, समुदायमा आधारित चोरी सिकार नियन्त्रण इकाई (community based anti-poaching unit-CBAPU) संचालन, जैविक मार्ग पुनरस्थापना तथा व्यवस्थापन कार्य गरी जैविक विविधता संरक्षणमा अतुलनीय भूमिका खेलेका।
- पृथक पृथक सावउसमा छरिएर रहेको स्रोत साधनलाई एकिकृत गरी सहकारी प्रकृया मार्फत वैकल्पिक उर्जा, साना उद्योग, आय-आर्जन, पर्यापर्यटन तथा स्थानीय रोजगारी सिर्जना गरी स्थानीय सम्बृद्धि गर्ने काम भएका।
- वासस्थानको निर्माण तथा भएका वासस्थान संरक्षण तथा सुधार पनि हुनुपर्छ कि?
- कार्यक्रमको सहयोगमा BIOGAS VER PROJECT संचालन गरी कार्बन व्यापारबाट आउने रकम उपभोक्ता समूहसम्म जाने व्यवस्था भएको छ। नेपालमा रेड (REDD) कार्यान्वयन हुँदाको

अवस्थामा स्थानीय सावउस र सहयोगी सरकारी गैरसरकारी निकायसँग सहकार्य गर्नसक्ने संस्थाको रूपमा आफूलाई खडा गरेको छ।

- लगातार १० वर्ष एकिकृत संरक्षण गरी दाङ जिल्लाको नर्ति चुरे क्षेत्रमा २५ वर्ष अघि सुकेका १४ वटा पानीका मूलहरू पुनरस्थापना गर्न सफल (नर्ति सावसस २०७१)। जलाधार संरक्षण तथा जलवायु परिवर्तन अनुकुलन कार्यमा सावको एकल प्रयासबाट हुन नसक्ने कार्यहरू सफलताका साथ संचालन गरेका।
- यस्ता कार्यहरू विस्तारै सुदृढ हुँदै अन्य क्षेत्रमा समेत बिस्तार (replicate) भएको देखिएको छ।
- संरक्षण तथा चोरी निकासी नियन्त्रण प्रभावकारी बनाउन इलाम जिल्लाको दक्षिणी क्षेत्रका ३ प्रमुख नाकाहरू विरिङ्ग, चुलाचुली र लोदीया दानावारीका सावउसको संजाल बनाई परिचालन गर्दा नयाँ अतिक्रमण, वन डढेलो नियन्त्रण गर्ने कार्यमा सफलता मिलेको (जिल्ला वन कार्यालय इलाम २०७१)।
- जिल्ला वन अधिकृत, अर्घाखाँचीबाट प्राप्त जानकारी अनुसार जिल्लाको दक्षिणी चुरे क्षेत्रमा सावउसको संस्थागत संजालीकरणबाट चुरे संरक्षण र चोरी निकासी नियन्त्रणको प्रयास हुँदै गरेको छ।
- जिल्ला वन कार्यालय पाल्पाका अनुसार भू-परिधि/उपजलाधारस्तरमा सावउसको संजालीकरणबाट जिल्लामा निम्न सिर्जनशील कार्यहरू सुरु भएका छन्
 - सिमावर्ती नवलपरासी जिल्लासँग जोडिएका हरियाली, केतुकी दमार, दुवारी र हरियाली सामुदायिक वन उपभोक्ता समूह संस्थागत रूपमा संगठित भै वन डढेलो नियन्त्रण, चोरी निकासी नियन्त्रण तथा एकिकृत चुरे संरक्षण कार्य।
 - जिल्लाको कंचन खोला, दोभान खोला तथा अरुणखोला जलाधार क्षेत्रमा चोरी निकासी नियन्त्रण, समुदायमा आधारित संयुक्त गस्ती तथा समग्र चुरे संरक्षण कार्य।

- जिल्ला सदरमुकामस्थित श्रीनगर क्षेत्रका ९ वटा सामुदायिक वनको संस्थागत सहकार्यमा जैविक विविधता संरक्षण तथा पर्यापर्यटन विकासको एकिकृत कार्य
- लोपोन्मुख गिद्ध संरक्षणका लागि सामुदायिक वनहरूबीच सहकार्य।

यसरी वन ऐन २०४९ तथा नियमावली २०५१ द्वारा स्थापित सावउसको काम कर्तव्य तथा अधिकारको सुदृढ गर्दै एकल घेराभन्दा माथि उठी नजिकका सावउसहरूको सहकार्यमा ठूलो तथा बृहत क्षेत्रमा संरक्षण गर्ने काम स्वतःस्फूर्त रूपमा सुरु भैसकेको छ। माथि उल्लेखित अनुभवलाई WWF Nepal को साभेदारीमा वन विभागद्वारा संचालित तराई भू-परिधि कार्यक्रम मार्फत संस्थागत गर्ने स्थलगत प्रयास भैरहेको देखिन्छ। दुई वा दुईभन्दा बढी सावउसबीच कार्यमूलक साभेदारी तथा सहकार्यबाट मात्र यस किसिमका कार्यहरू सफल भएका हुन्। आपसी तथा संस्थागत सहकार्यबाट सहभागी सावउसको काम गर्ने क्षमता मात्र बढ्ने छैन, भू-परिधिस्तरमा संरक्षण तथा सम्बृद्धिको लागि थप अवसरको ढोका समेत खुलाउने पुष्टि भएको छ।

४.५ सावउस संजालीकरण तथा सहकार्यबाट सिर्जना हुन सक्ने थप अवसरहरू

आबद्ध समूहहरूले समेटेको भौगोलिक क्षेत्र (जलाधार, जैविक मार्ग, सिमसार क्षेत्र, बाघ, गैडा तथा हात्ती जस्ता संकटापन्न वन्य जनावरको वासस्थान आदि) र त्यसबाट प्रभावित क्षेत्र यस्ता संजालका कार्यक्षेत्र हुन सक्दछ। यस किसिमका सहकार्य र संस्थागत संजालीकरणले निम्न किसिमको थप अवसरहरूको सिर्जना गर्न सक्दछ।

- वन्यजन्तुबाट हुने क्षतिको राहत प्रदानको लागि सामुदायिक स्तरको तत्काल व्यवस्था गर्न सकिन्छ, प्रतिशोधबाट अभिप्रेरित भई वन्य जनावरको हत्या गर्ने प्रवृत्ति रूपान्तरण भै सह अस्तित्वको भावना जगाउन सकिन्छ।



द्वन्द्वमा दुवैको हार भएको अवस्था



- संगठित सावउसको स्रोत साधन तथा जनशक्ति परिचालन गरी महत्वपूर्ण प्रजातिको वासस्थान संरक्षण, घाइते तथा अनाथ वन्यजन्तुको उद्धार तथा प्राकृतिक वासस्थानमा छाड्ने व्यवस्था मिलाउन सकिन्छ।
- सावमा वैज्ञानिक वन व्यवस्थापनको लागि community forest bundling, निश्चित वन पैदावार उत्पादनको लागि भू-परिधिस्तरमा product bundling मार्फत बजारीकरणमा टेवा पुग्ने।
- अन्तर समूहमा र सरकारी निकायसँग सूचना अदान प्रदानबाट वन्य जनावरको अवैध व्यापार नियन्त्रणमा समुदाय स्वयं संलग्न हुन सक्ने तथा सरकार र सरोकारका निकायलाई समुदाय स्तरबाट सहयोग पुग्नेछ।
- भू-परिधिस्तरमा वन विनास तथा क्षतिकरणका कारक तत्वलाई सम्बोधन र रेड (REDD) कार्यान्वयनमा समुदायको भूमिका सुदृढ गराउन, सहकार्यबाट चुहावट नियन्त्रण, वन्य प्रजाति तथा वासस्थान संरक्षण, सामुदायिक चोरी शिकार प्रतिरोध, वासस्थान पुनर्स्थापना तथा व्यवस्थापन, जलाधारमा पानी प्रदूषण नियन्त्रण, जलवायु परिवर्तन प्रभाव अनुकूलन मार्फत समुदाय तथा पारिस्थिकीय प्रणालीको resilience building जस्ता कार्यक्रम संचालन गर्न समुदायको श्रोत परिचालन।
- सुशासन सबलीकरण: अन्तर समूह सार्वजनिक सुनुवाई तथा संयुक्त अनुगमन मार्फत जिल्ला वन कार्यालय र स्वयं समूहको सुशासन सबल हुने। Isolation मा काम गर्ने प्रवृत्ति भएका समूह र सहयोगी कर्मचारीबाट हुनसक्ने विसंगतिको न्यूनीकरण मार्फत काम प्रतिको उत्तरदायित्व बढ्ने।
- एकै संजालभित्र तल्लो र माथिल्लो तटीय समुदाय आवद्ध हुने हुँदा एकिकृत चुरे संरक्षण, वातावरणीय सेवा भुक्तानी कार्यान्वयन गर्न सहज हुने।
- सहभागी सावउस तथा अन्य समूहहरूको क्षमता अभिवृद्धिका लागि वैकल्पिक सेवा प्रदायकको रूपमा यस्ता संजालको भूमिका बलियो हुने।

४.६ संस्थागत गर्ने उपाय

- १) बृहत भू-परिधि क्षेत्रमा (landscape level) वन्यजन्तु संरक्षण तथा वासस्थान व्यवस्थापन, संलग्न समुदायको जीविकोपार्जनमा सुधार तथा सम्बृद्धिका लागि दुई वा दुईभन्दा बढी सावउसको संस्थागत तथा कार्यमूलक साभेदारी तथा सहकार्य (functional partnership and collaboration) को नीतिगत तथा कार्यक्रमिक व्यवस्था मिलाउने। यस्तो साभेदारी तथा सहकार्य उपजलाधार, जैविक मार्ग, वासस्थान, सिमसार, इलाका वा आवश्यकता अनुसारको क्लस्टरमा गर्न सकिने व्यवस्था सामुदायिक वन विकास कार्यक्रमको मार्गदर्शन २०६५ मा गर्ने।
- २) जिल्ला वन कार्यालयहरूमा यस किसिमका संरचनाहरू दर्ता गरी सामुदायिक वनहरूले एकल रूपमा गर्न नसकिने कार्यहरूको पहिचान गरी क्लस्टर स्तरमा कार्ययोजना तयारी, स्वीकृति तथा कार्यान्वयन गर्ने व्यवस्था हुनु पर्ने (निकुन्ज/आरक्षको मध्यवर्ती क्षेत्रबाट ठूलो पाठ सिक्न सकिन्छ)।
- ३) हाल जिल्ला वन कार्यालय तथा जिल्ला भू-संरक्षण कार्यालयहरू मार्फत संचालन हुने उल्लेखित प्रकृतिका कार्यहरू यस किसिमका संरचनाहरूसँग साभेदारी तथा सहकार्य गरी गर्ने व्यवस्था मिलाउने।
- ४) वन तथा भू-संरक्षण मन्त्रालय अन्तरगत संचालन हुने साना उद्यम, वैकल्पिक उर्जा, रोजगारी तथा आय आर्जन जस्ता सम्बृद्धि बढाउने कार्यक्रमहरूलाई नेपाल सरकारको लघु उद्यम नीतिसँग तालमेल मिलाई पहिचान गरिएका क्लस्टरमा सहकारी मार्फत कार्यान्वयनमा ल्याउने।

५.० निष्कर्ष

एकलो समूहको क्षमता भन्दा बाहिरका र दुई वा दुईभन्दा बढी समूहको संस्थागत सहकार्य तथा साभेदारी अपरिहार्य हुने एकिकृत संरक्षण तथा सम्बृद्धिका नविन सवालहरूलाई नीतिगत तथा कार्यक्रमिक रूपमा



सम्बोधन गरेर मात्र सही मानेमा हाम्रो वन क्षेत्रलाई सम्बृद्ध तुल्याउन सकिन्छ। साव/सावउस रूपी अंश अंशलाई सुरक्षित गर्दै विहंगम भू-परिधि स्तरीय समग्रतामा वन विकास, वन विकास मार्फत सम्बृद्ध वन र समुदायको सम्बृद्धि सँगै मानव वन्यजन्तु द्वन्द्व न्यूनीकरणका वर्तमान चुनौतिहरूको सामना गर्ने सर्वथा सुगम बाटो यही हुनेछ।

६.० धन्यवाद ज्ञापन

- क) वन विभाग, जिल्ला वन कार्यालय पाल्पा, तराई भू-परिधि कार्यक्रम र सहयोगी डब्लुडब्लुएफ नेपाल कार्यक्रम प्रति आभारी छु। सम्पर्क गरिएका जिल्ला वन कार्यालय र जिल्ला वन अधिकृतहरूप्रति हार्दिक आभार व्यक्त गर्दछु।
- ख) प्रस्तुत मृत मानिसको फोटो उपलब्ध गराउने पहलमानपुर सामुदायिक वन समन्वय समिति कैलाली र तराई भू परिधि कार्यक्रमका सामाजिक परिचालक तिलकराम चौधरी प्रति हार्दिक धन्यवाद व्यक्त गर्न चाहन्छु।

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SECTION III

Contribution of Community Forestry in Conservation of Biodiversity Including Vulture

(An experience from Kalika CFUG, Dang, Mid-Western Nepal)

Krishna Prasad Yadav¹ and Kamlesh K Yadav²

Abstract

Nepal is one of the richest country in biodiversity due to its unique ecology and altitudinal variations. The country has pioneering experience of world recognized Community Forestry (CF) for decades. Kalika Community Forestry User Group (CFUG) of Dang district has implemented a number of activities to conserve the Biodiversity (BD). Among them, the CFUG has initiated conservation of Vultures by establishing an *Oldage Animal Shelter* (Pashu Bridha Ashram) and a *Vulture Conservation Committee* since 2065 B.S. Nepal Government has also developed and implemented “Vulture Conservation Action Plan 2009-2013” with the main objective to prevent the extinction of Vulture species by ensuring re-introduction, safe food supply, maintenance of suitable habitat and better understanding of the ecological importance of these birds in Nepal.

Furthermore, Kalika CFUG has specific provision in its Operational Plan (OP) to increase floral and faunal diversity. The CFUG has been implementing the plan and encouraging results are being observed in biodiversity conservation within the CF.

This paper aims to explore the activities implemented related to biodiversity conservation in the CF. It also tries to document the process and impacts of biodiversity conservation effort by CFUG members including the constraints and opportunities for future. Observation of the *Oldage Animal Shelter*, interaction with the CFUG members and reviewing the related documents are the main methods implemented for this study.

Different initiatives have increased the level of awareness of the CFUG members. CFUG has organized awareness campaign and activities on biodiversity conservation. The *Oldage Animal Shelter* and *Vulture Conservation Committee* are well functioning. CFUG has provision to make life member as nature's friend (Prakriti ko Sathi), for sustainable development and about 475 national and international life members have been involved and supporting this initiatives. Other initiatives include provision of biodiversity focused forest management practice in the OP i.e. protecting the big and mature/over mature trees within the CF, formation and mobilization of poaching eradication committee, etc.

The results are clearly observed in the increased of number of vulture and other species of wild animals (*Rabbit, Leopard, Wild dog, Barking deer, Spotted deer* etc.) and birds (*Dhanesh, Bajha, Kalij, Chibe* etc.). Floral diversity has also increased. The densities of major species like Sal (*Shorea robusta*), Saj (*Terminalia tomentosa*), Khayer (*Acacia catechu*), Simal (*Bombax ceiba*), Karma (*Adina cordifolia*) etc. have increased with compared to the time of CF hand over. Some new species like Amala (*Emblica officinalis*), Baidar, Tilka, Parijat have also come up as a result of protection and management CF. Key Informants Interview revealed that initiative of vulture conservation brought positive attitudinal changes in CF users, which made the users more sensitive to conserve floral and faunal diversity.

The study concludes that Community Forests across the country should be considered reliable medium of biodiversity conservation. For this, further orientation and capacity building of CFUG members seem to be intervened to ensure adequate provisions of biodiversity conservation in CFUGs' OPs.

Key words: Vulture, Community Forest, Biodiversity, Conservation

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1.0 BACKGROUND/ INTRODUCTION

Nepal is one of the richest country in biodiversity due to its unique ecology and altitudinal variations. Total of 208 mammals, 872 birds, 123 reptiles, 117 amphibians, 217 fishes, 192 mollusca, 3958 moths, 651 butterflies, 175 spider species have so far been recorded in Nepal (NBSAP, 2014-2020). Kalika Community Forestry Users Group (CFUG) at Lalmatiya Village Development Committee (VDC) of Dang district, in Mid-West Development Region of Nepal. Kalika CFUG has been doing biodiversity conservation activities for last few years. The CFUG has incorporated the biodiversity conservation activities in their longer Operational Plan (OP) as well as in their annual plans.

Few years ago, in the plains of the Nepal, Terai, Vultures were seen in large numbers. But, it is not so these days. These beautiful creatures, which feed on dead animal's carcasses helping to maintain a clean environment and reducing odor emanating from dead and decaying matter, are today facing the threat of extinction. Many species of Vultures are now listed as endangered. Witnessing the steep decline in the number of Vultures in the surrounding area, the Kalika CFUG initiated a program for Vulture conservation in November 2008. A new and innovative concept of an oldage animal shelter locally called as "Vulture Restaurant" was brought into action. Where naturally dying, sick, and old could be tended and after they died, fed to the vultures. The major objective of this program is to promote community led conservation effort. WWF, Terai Arc Landscape (TAL) program and Bird Conservation Nepal (BCN) have provided technical and financial support to continuously run the shelter. At present, no any support from outsider exists. But the initiative has been continued by the users, understanding the value of biodiversity conservation. The initiative has attracted regular visits by the national and international visitors. Better understanding on biodiversity conservation has motivated the users to conserve other biodiversity as well in the locality.

The country has pioneering experience of world recognized Community Forestry (CF) for decades. Initially the CFUGs had given priorities to conserve the CF to fulfill the basic needs of the user, but now the paradigm has shifted and CFUGs have now been involved in conserving the

biodiversity and commercializing the CF products. Kalika Community Forestry User Group (CFUG) of Dang district has implemented a number of activities to conserve the Biodiversity (BD).

2.0 OBJECTIVES

The major objective of the report is to evaluate the contribution of Community Forestry in conservation of Biodiversity including *Vulture*. The specific objectives of the study are:

- To find out initiatives taken by CFUGs
- To find out change in floral and faunal biodiversity
- To find out key issues of biodiversity conservation
- To explore/recommend way forward

3.0 MATERIALS AND METHODS

This paper has been prepared based on the review of CFUG's constitutions (old and new), Operational Plans (new and old) and other records and documents maintained by the CFUG. Discussions with CFUG members and executive committee members, discussion with forest professionals, conservation professionals and other focus groups were held to explore the facts in relation to the objectives of the study. Thus, exploratory approach has been followed for the study.

3.1 Study area

This study was carried out in Kalika CFUG, which lies Lalmatiya VDC-4, Dang district. Total of 3715 population have benefited from the CF, details are given in Table 1 below. The HHs covers Janjati 61%, Brahmin Chhetri Newar (BCN) 36%, Dalit 2% and other minority cast 1%. The CF is divided into 4 blocks for management of forests and the forest has tropical species like Sal, Asana, Karma and their associates.

TABLE 1: BASIC INFORMATION ABOUT THE STUDIED CFUG

S.N.	Attributes	Now	At hand over
1.	CF Area in ha.	465.25	449
2.	No. of Households	615	514
3.	Population benefited- Total	3715	2882
4.	Population benefited – Female	1797	1378

3.2 Data Collection

Both primary and secondary data were collected for the study. Observation of the CF including the Vulture restaurant, discussion with CFUG committee members and general members, discussion with key informants and focus groups (poor and disadvantaged) were held to collect the data. CFUG constitutions, Operational Plans, records and registers maintained by the CFUG, different resources available at District Forest Office, Bird Conservation Nepal and other institutions were also reviewed for the purpose.

3.3 Data Analysis

Data collected for this study were descriptively analyzed and the findings have been interpreted to respond the objectives of the study.

4.0 RESULTS/FINDINGS

4.1 Initiatives for Vulture Conservation

The Kalika CFUG has been carrying out different activities for the conservation of Vulture since November 2008. The CFUG was supported by World Wildlife Fund (WWF), Terai Arc Landscape (TAL) project and Bird Conservation Nepal (BCN). The core idea under this innovative lies with the establishment of "Vulture Restaurant" to ensure appropriate location for the Vultures. Carcass of the animals is maintained in the restaurant which attracts Vulture. Old animals are kept inside the restaurant and once they die it becomes food materials for the Vulture. The interaction with CFUG members revealed that they decided to keep bigger/ taller trees after they once watched nest of a Vulture on Sal tree. Besides, the CFUGC has formed a Vulture Conservation Committee with clearly defined roles and responsibilities. The committee is now functioning well. In addition, there is a monitoring committee which conducts regular monitoring of the activities.

The effort by the CFUG members supported by development agencies has resulted into the increased number of Vulture coming in the restaurant as well as increased number of their nests on the trees inside the CF. The numeral range of absolute population size of the critically endangered Vultures: *Gyps bengalensis*, *Gyps tenuirostris* and *Sarcogyps*

calvus were found to be 44, 21 and 18 respectively in Dang Deukhuri valley (Shrestha, 2010), which is largest number found in Deukhuri valley providing evidence of increased number. Nesting of critically endangered White-rumped Vulture in the vicinity also sets an evidence of increased population of Vulture.

4.2 Change in Forest Resources

Community Forestry across the country has well protected the forest lands and has contributed a lot to bring positive change in the forest resources. Kalika CFUG has its own CF Operational Plan (OP) and has been implementing it since the handover of CF. The OP is prepared for a period of five years and two amendments have already been made to the first one, thus third OP is being implemented by the CFUG and a number of achievements have been noticed from the perspectives of biodiversity conservation. Focus Group Discussion with the senior members of the CFUG found that their own observation of CF claims increased growing stock as well as in number of plans species. The comparison of densities of regeneration, poles and trees at two points of time: 2005 and 2011 shows the densities have increased as shown in table 2.

The review of first OP implementation given in the first revised OP 2005 revealed that CFUG members extracted: 196,200 Bhari (headload) of fuel wood, 50,000 bhari of ground grass and 9,214 cubic feet of timber from the CF within the first 5 years. The availability of forest products such as firewood, timber, fodder, agricultural implements, leaf-litter has also increased over the period due to implementation of CF OPs.

Occurrence of forest fire is common in Terai areas, but Kalika CFUG has special provision to prevent forest fire. Fire Control Unit/committee formed by the group is functional in monitoring forest fires. Fire lines have also been constructed inside the forest. Construction of the fire lines and regular patrolling have contributed to favorable environment for Vultures as well as for increased forest species.

It is widely recognized that prevalent forest management strategy of CFUGs is protection-oriented or passive (Acharya 2002; NPC 2001; Shrestha 2000; Branney 1996;

TABLE 2: REGENERATION AND POLES DENSITIES AT TWO POINTS OF TIME

Attributes	CF Operational Plan in 2005	CF Operational Plan in 2011
No of regeneration (per ha)	13571	15946
No of sapling (per ha)	2057	2557
No of Balabali (per ha)	315	876
No of pole per ha)	400	545

Karki *et al.*, 1994) resulting in fewer benefits than otherwise could have been. The term "protection-oriented" refers to the forest management system allowing only for the collection of dry wood and twigs as well as certain non-wood forest products (NWFPs) such as leaf litter for animal bedding and compost (Branney, 1996). The Kalika CFUG has also been practicing conservation oriented management rather than active forest management. It is also noteworthy that protection and conservation oriented effort are fruitful for biodiversity conservation.

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Priority of CFUG has been found on biodiversity conservation because provisioning of biodiversity conservation has been specified in the OPs in both the revisions in 2005 and 2011 which was not in the first one at the time of hand over. Similarly, the users have divided their CF into 4 blocks and number 4 block has been defined for biodiversity conservation focus. The protection of degraded forest through community forestry has improved forest condition in the hills of Nepal and has positive impacts on biodiversity conservation (HMG/N 2002; McNeely 2002; Malla 2000; aus der Beek *et al.*, 1997; Jackson and Ingles 1994). Similarly, the increased greenery in the hills has positive impact in conserving water sources and controlling soil loss (Acharya, 2004).

4.3 Change in Floral Diversity

The CF area has been fully protected from illegal harvesting and grazing since the hand over. Plantation inside the CF was done after the CF hand over. Users noticed that new species found inside of CF in naturally growing forest patches and inside the planted area. As per CF OP, the species such as Sal (*Shorea robusta*), Khayer (*Acacia catechu*), Asna (*Terminalia tomentosa*), Sidha, Jamun (*Syzgium cumini*), Ipillpil, Bakaino (*Melia azaderach*), Rohini, Sisoo (*Dalbergia sissoo*), Dhairo (*Lagaestromia parviflora*), Pyar, Kali kath, Raj briksha (*Casia fistula*) seen in CF OP 2005 and the species Bhalayo, Sal, Khayar, Sadan, Rohani, Sisoo, Pyar, Asana, Amala, Baidar, Tilke, Simal, Parijat, Sidha, Kusum and Dabdabe were found in CF OP 2011. Thus, the comparison of species between over two period reveals that few species i.e. Jamun, Ipillpil, Bakaino, Dhairo, Kalikatha and Raj briksha were found new in 2005 and Amala, Bhalayo, Baidar, Tilke, Simal (*Bombax ceiba*), Sadan, Parijat, Kusum (*Schliechera oleosa*) and Dabdabe seen in CF OP 2011. CFUGs shared that few species such as Amala, Baidar, Tilke, Kusum, Dabdabe which were disappeared due to different causes now have appeared. This is result of biodiversity conservation effort by the members.

4.4 Change in Faunal Diversity

Due to favorable environment and improved habitate has increased density of poles and saplings and increased jhadi/shrubs inside the CF, some wild life species such as Leopard, Bear, Wild dog, Rabbit, Barking deer, Spotted deer, Wild boar, Wild cock, Vulture and other birds have been observed inside the CF area. CFUG/C also noticed that comparatively more wild lives have been observed in the CF than other CF and nearby national forest. CFUG assembly attendees last year witnessed when one group of barking deer came to drink water into the pond and went back without any fear with the mass of people. A pond has been constructed by CFUG/C, to protect water source near the CFUG building/ meeting place for multiple use of water.

4.5 Species relocation into the CF

About two years ago, one Anaconda (Ajinger) was found in the Rapti River. The CFUG members rescued and released inside their CF. Few people noticed that the Anaconda is still alive inside the CF. This type of enthusiasm shows that the CFUG members are active and keen to conserve the biodiversity. Such effort can be considered key to the success of the CFUG to won the Abraham Conservation Prize.

4.6 Other Initiatives and Achievements

Fund Generation: Prakriti ko Sathi (Nature's Friend) is a kind of nature lovers' club/forum inside Kalika CFUG. Anyone interested to join the initiative i.e. national/international individuals or organizations can join with certain amount contribution as donations. As of August 2015, there are 553 members in the club. Among them, international organizational life member is 1, International personnel life members are 105, national organizational life members are 13 and national personnel life members are 434. The trend of the members is increasing in number. Membership fee is defined as minimum of NRs 500.00 for nationals and NRs 1000.00 for internationals. Anyone visiting the CFUG can become a member by registering his/her name and paying the minimum amount, but can contribute as desired, maximum of NRs 5000.00 has been donated by one person. There has been total amount of NRs 1,000,000.00 in the club and been deposited in fixed account. The interest generated there from is being utilized for paying staff employed for the taking care of the restaurant and feeds for the cattle kept in the restaurant.

CFUG has done plantation on the barren land inside the CF with the support from Armed Police Force (APF) unit located inside the CF. This support has been bridged upto some extent the distance between the CF and APF because CFUG is not happy with the decision of the government for locating APF office inside the CF.

5.0 MAJOR ISSUES AND CONCERNS

5.1 Support from District Forest Office

District Forest Office (DFO) is responsible to support the CFUG technically but DFO support to the CFUG could not be noticed since Vulture establishment. Consultations with the members revealed that DFO did not support due to external support from WWF-TAL and BCN. However, as there is no external support currently, DFO support to CFUG seems invaluable. Moreover, support from DFO will be important to enable CFUG members to maintain records on different activities and results at different points of time i.e. since the CF hand over.

5.2 Support from WWF-TAL, BCN and other agencies

Currently the CFUG is not getting any external support. The support from WWF-TAL and BCN ended last year. Focus Group Discussion held with CFUG committee member revealed they need a kind of follow up support till the CFUG becomes self-sustaining.

5.3 Surrounding settlement and possible disturbance

There are settlements around the CF at the Chure foothills. CFUG members are scared with the possible events of fire, grazing etc. from the local people. Such activities will impact in degradation of forest, loss of biodiversity and finally unfavorable environment for the Vultures.

5.4 Pro-poor activities for poor

CFUG members are well motivated towards conservation of Vulture and other biodiversity inside CF. Some parts of CF land have already allocated for conservation purpose, which ultimately limits cultivation of NWPFs or income generating species. But, users' motivation can only be ensured if they are engaged in alternative activities for raising their household incomes.

5.5 Distribution of CF area for other purpose

About 26 ha of CF area has been separated for Kamaiya's settlement and Armed Police Force (APF) through the government decision. Out of which 14 ha has been used by APF. CFUG members are not confident that such decisions could not happen in the future.

6.0 CONCLUSION

The study concludes that local communities especially CFUG can be considered as a reliable vehicle for biodiversity conservation. Once the benefits and importance of biodiversity conservation are acknowledged by the CFUG members, they become self-motivated to implement any initiative. The evidences can be sought from Kalika CFUG as explained above. CFUGs started the activities for Vulture conservation and concluded with a number of successful effort in conservation and promotion of floral and faunal diversity.

7.0 RECOMMENDATIONS

Based on the study findings, following points could be considered as recommendations toward further endeavor for biodiversity conservation in general and for promoting current practices by Kalika CFUG:

- Development agencies: WWF-TAL, BCN and other potential ones should be further coordinated to support the current initiatives and practices by Kalika CFUG.
- The findings and results of the initiatives should be disseminated to wider audience.
- New initiatives and innovations on biodiversity conservation should be integrated in CF Operational Plan.
- CFUG members should be well oriented on Biodiversity Registration/Documentation for future significance.
- Further dialogue should be done to ensure CF is safe from encroachment and other disturbance from local people/settlements.
- Income Generation Activities should be planned and implemented for CF users. For this purpose, collaboration with external agencies could be useful. At district level DFO could be considered as appropriate medium to further this.
- Fund raising should be continued by CFUG for sustaining the Vulture restaurant and other initiatives.

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Community Intervention in Conservation of Biodiversity in Barandabhar Forest Corridor

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Abstract

Barandabhar forest corridor is a tropical forest which joins Chitwan National Park with the Mahabharat range to the north and covers an area of 161 km². It is also a very important biological corridor for the Gandaki river basin, connecting the Terai with higher altitude areas. The human population nearby the corridor is putting high pressure on forest ecosystem. This study explored and analyzed community involvement in the biodiversity conservation in four community forests of Barandabhar corridor, using an integrated analysis and synthesis of available secondary data and information, stakeholder consultation, satellite image analysis and field survey. Community forests have adopted forest restoration approach to reduce deforestation and biodiversity threats in the Barandabhar corridor with an aim of recovering ecological integrity and enhance human wellbeing in degraded or deforested forest with emphasis on improving connectivity and linkages of degraded forest patches through forest restoration. Satellite image analysis between 2009 and 2015 reveals that non-vegetated area in the corridor has decreased which is being gradually replaced by medium vegetated area. However, the high vegetated area has not changed significantly. This shows that habitat condition of the corridor is improving gradually. Apart from this, regeneration condition, density and growing stock volume of both poles and trees have increased significantly after community forests intervention. The area is rich in faunal diversity. However, the diversity of mammals has slightly decreased due to anthropogenic disturbance and the east-west highway which cuts across the corridor with high volume of traffic, disturbing wildlife movement in corridor.

Key words: Community Forest, Biodiversity Conservation, Barandabhar Corridor

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1.0 INTRODUCTION

Government of Nepal has been implementing participatory forest management programmes, which have made substantial contribution to forest conservation, enhancement of local livelihoods and strengthening biodiversity-livelihood linkages. The programmes also became socially more inclusive in recent years (Kanel and Kandel, 2006; USAID, 2012; MoFSC, 2013). Department of Forests has been managing forests and corridors outside protected areas (PAs) for the conservation of biodiversity and management of forest under five different management regimes following Forest Act 2049: Government Managed Forest, Protection Forest, Leasehold Forest, Religious Forest and Community Forest (MoFSC, 2014). Forest degradation and loss has declined substantially and even reversed in many areas, particularly in the Middle Mountains, after implementation of the community forestry programme began (Gautam, 2006; Niraula *et al.*, 2013). Community forests are directly contributing to conservation of biodiversity and forest management. Although, the planning and design of community forest management has not specifically considered biodiversity assessment and conservation, improvement in forest conditions under communities' management has positively contributed to biodiversity through the creation of habitat corridors and development of successive stages of forests (Gautam, 2009).

Barandabhar forest corridor lies between Chitwan National Park (CNP) and the Mahabharat range within the Terai Arc Landscape of Nepal. Approximately 75% of this landscape was previously forested, supporting a rich diversity of flora and fauna (Joshi, 2002; Bennet, 2004). Since the 1950's however, the area has been subject to deforestation. This is largely due to an influx of people attracted by the fertile soils and to the launch of the Rapti Doon Development Programme, which encouraged deforestation for agriculture and the conversion of private forest to national forest (Shrestha, 2001; MOPE, 2002). Subsequently, the Barandabhar forest corridor is the only remaining natural forest with an area of 161 km² that connects the CNP and the Mahabharat range (Bhattarai, 2003), allowing the endangered *Rhinoceros unicornis* and *Panthera tigris tigris* access to refuge at higher altitudes during monsoon season (Tiwari *et al.*, 2007). It is also a very important biological corridor for the Gandaki river basin, connecting the Terai with higher altitude areas. The human population around the corridor is over 50,000 (CBS, 2011), imparting excessive pressure on its ecosystems. Retention and restoration of such ecological corridors, linking protected areas, are considered essential in maintaining and restoring wildlife populations across south and central Asia (Tiwari *et al.*, 2007).

Community forests have been imparting contribution for the conservation of biodiversity in Barandabhar corridor over six years. Regardless of their vital role in the conservation of biodiversity, there is presently unavailability in literature with particular reference to the community efforts and results in conservation of biodiversity in Barandabhar corridor. The present study is

an attempt to document community efforts in conservation of biodiversity in Barandabhar corridor.

2.0 OBJECTIVE

The overall objective of this study was to assess community intervention in conservation of biodiversity in Barandabhar corridor. The specific objectives include:

- To identify changes in forest cover and wildlife habitat in Barandabhar corridor
- To assess growing stock and regeneration status
- To quickly assess diversity of birds and wild animals in the corridor

3.0 MATERIAL AND METHODS

Barandabhar forest corridor is located in Chitwan district of Nepal between 27° 43' and 27°42' N latitude and 84°25' and 84 ° 34' E longitude, covering an area of 161 square kilometres. The elevation ranges from 200 meters to 650 meters. Physiographically, the corridor can be divided into two major zones: the Siwaliks, and midhills, having tropical mixed deciduous forest dominated by *Shorea robusta* (Aryal *et al.*, 2012). It has a tropical monsoon climate, average maximum temperature recorded is 35° C in summer while the average minimum temperature is 14 °C recorded during the winter (Aryal *et al.*, 2012). Over 90 percent of the annual precipitation occurs during monsoon between June and September. Average annual precipitation is around 1500-1600 mm with maximum concentration around July-September (Aryal *et al.*, 2012).

The study was conducted in four different community forests namely Tinkanya Community Forest User Group, Ranikhola Community Forest User Group, Kalikhola Deurali Community Forest User Group and Chandithan Community Forest User Group of northern part of Barandabhar corridor forest which lies Dahakhani and Kabilash Village Development Committees of Chitwan district. Table 1 and Map 1 illustrates study area.

Secondary data and information was collected through review of relevant literature and reports. The study used secondary sources of information to identify various birds and mammals found in the Barandabhar corridor. Likewise, the study also reviewed operational plan (OP) of community forests user groups (CFUGs) to assess regeneration, poles and trees condition and growing stock volume, provisions and programs related to biodiversity conservation. Group discussions and key informant interviews were used to collect primary data and information. Likewise, forest inventory was carried out to (a) assess regeneration, poles and trees condition and (b) changes in regenerating conditions and growing stock volume after the community intervention using the Community Forestry Inventory Guidelines, 2061 in four CFUGs. Likewise line transects count Sutherland

TABLE 1: STUDY AREA

SN	Name of Community Forest User Group (CFUG)	Area (Ha.)	Latitude and Longitude	Forest Type
1	Ranikhola CFUG	826.02	27°44'55.51"N 84° 30' 50.49"E	Sal (<i>Shorea robusta</i>) forest
2	Tinkanya CFUG	152.84	27°43'59.46"N 84° 31' 50.70"E	Sal (<i>Shorea robusta</i>) forest
3	Chandithan CFUG	497.47	27°43'42.96"N 84° 33' 11.27"E	Sal (<i>Shorea robusta</i>) forest
4	Kalikhola Deurali CFUG	367.80	27°43'19.50"N 84° 34' 20.72"E	Sal (<i>Shorea robusta</i>) forest

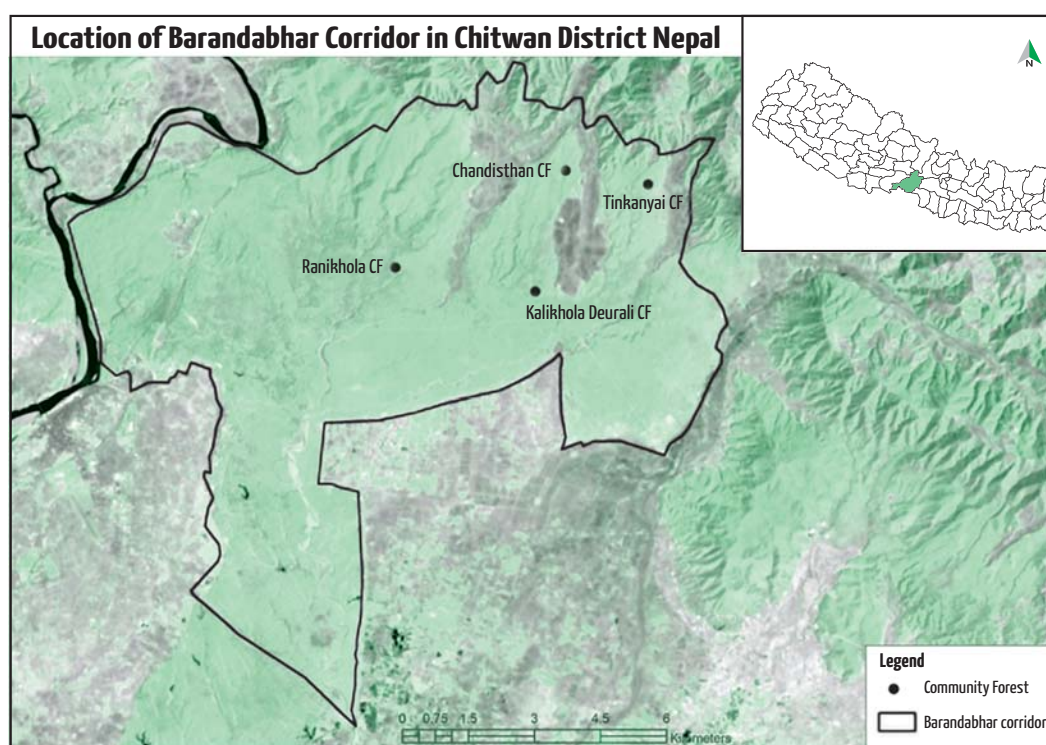
(1996) was also followed to estimate diversity of birds and mammals in the corridor. This study used satellite images of Landsat 7 and Landsat ETM + of April, 2009 and April, 2015 for vegetation cover mapping and change analysis following Rouse *et al.*, 1973.

4.0 FINDINGS

4.1 Community Intervention

Community Forest User Groups (CFUGs) have adopted forest restoration approach for conservation of biodiversity in the Barandabhar forest corridor with an aim of recovering ecological integrity and enhance

human wellbeing in degraded or deforested forest with emphasis on (a) Integrated and participatory approach to the planning and implementation (b) Linking benefits from conservation with rural livelihood improvement and (c) Improving connectivity and linkages of degraded forest patches through forest restoration. Community Forest User Groups have implemented programmes in four thematic areas during 2009-2014, which includes (a) forest conservation (b) livelihood improvement (c) social development (d) institutional development. During 2009 to 2014, CFUGs have invested NRs 34.7 million for forest restoration of Barandabhar corridor. Chart 1 illustrates thematic financial expenditure made between 2009 and 2014.



Map 1: Location of Study Area

4.2 Changes on habitat condition

Habitat condition of the corridor is improving gradually as a result of both the primary and secondary successions. Primary successions are taking place in the sites which have previously no vegetation. This includes riverine area where *Imperata cylindrica*, *Chloromela ordata*, *Mikania macarantia*, *Saccharum spontaneum*, *Cyperus rotundus*, *Desmostachya bipinata*, *Saccharum munja*, *Misconthes nepalensis* and *Carex vesicularosa* species have appeared. These species is being gradually replaced by *Acacia catechu*, *Dalbergia sisoo*, *Cassia fistula* and *Trewia nudiflora*. Likewise, secondary successions, i.e. development of vegetation after destruction of the whole or part of the original vegetation are occurring in the corridor as a result of strict protection measures adopted by the communities. Map 2 and Map 3 shows changes on habitat condition. Table 2 analyses changes in vegetation cover during 2009 and 2015. The non- vegetated rear in the corridor has decreased which is being gradually replaced by medium and high vegetated area. This shows that habitat condition of the corridor has improved, which is mainly because of plantation, control of grazing, forest fire and encroachment including protection of forests.

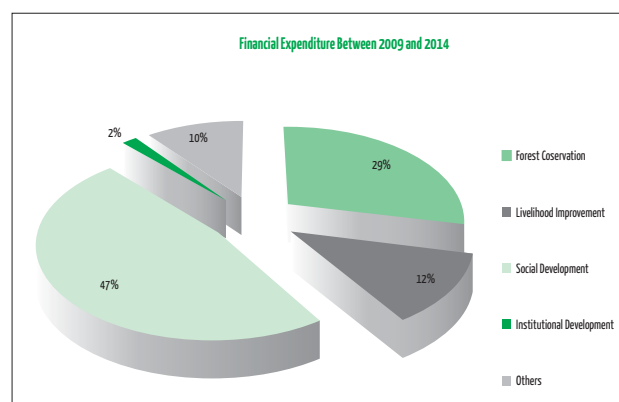
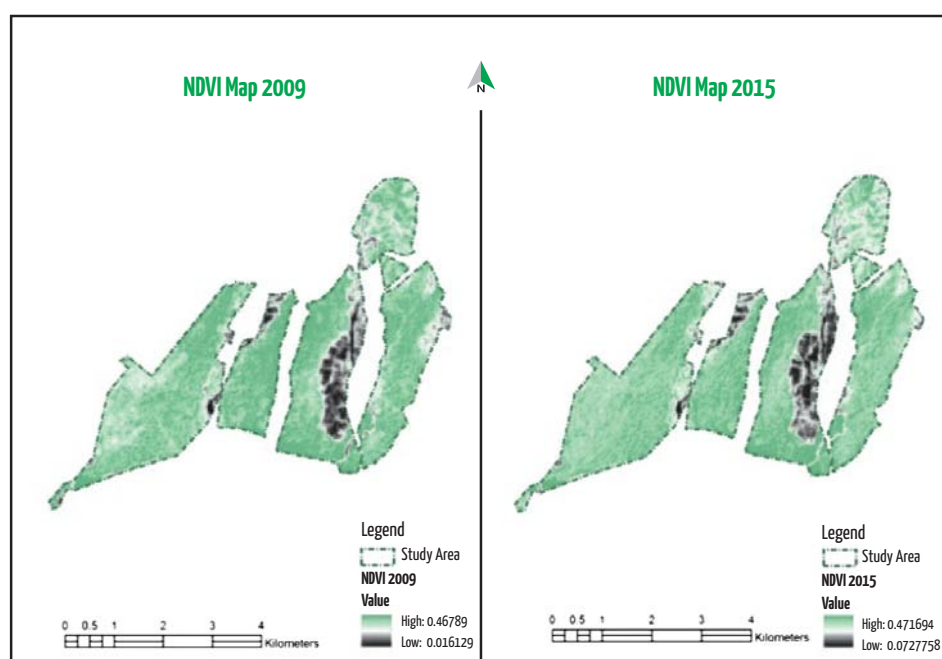


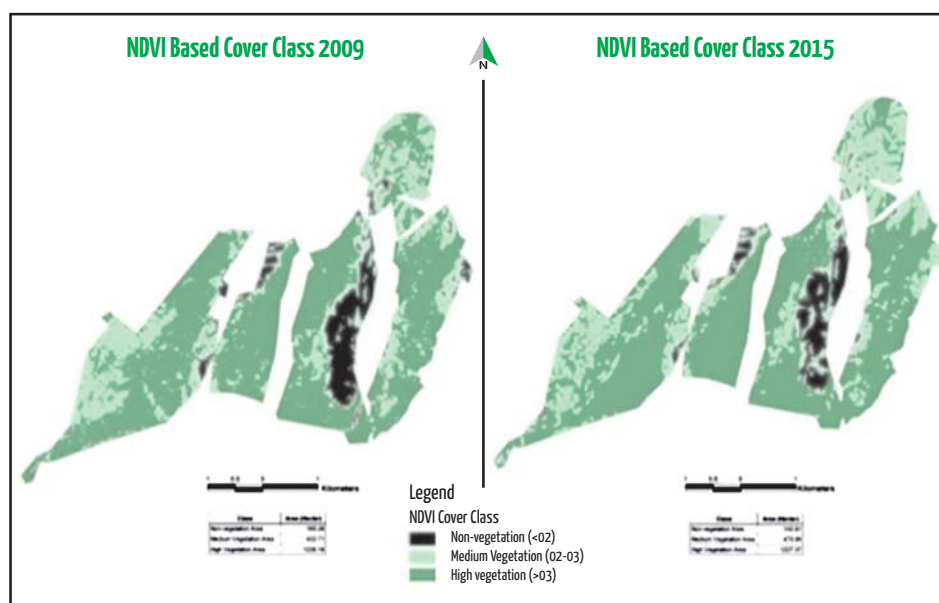
Chart 1: Theme wise financial expenditure between 2009 and 2014.



Map 2: NVDI based vegetation cover map

TABLE 2: CHANGES IN VEGETATION COVER BETWEEN 2009 AND 2015

Class	NDVI Threshold	Vegetation area (ha)		Change		Status
		2009	2015	Area (ha)	%	
Non-vegetated	Less than 0.2	185.26	142.81	42.45	22.91	Decreased
Medium vegetated	0.2 to 0.3	432.71	473.95	41.24	9.53	Increased
High vegetated	Above 0.3	1226.16	1227.37	1.21	0.1	Increased
Total		1844.13	1844.13	84.90		



Map 3: NVDI based vegetation cover map

4.3 Changes on forest condition

Table 3 compares changes on forest conditions before (2009) and after (2015) community intervention. Before situation was created through the review of community forestry operational plan while after situation was computed based on forest inventory results. Number of seedling, saplings, poles and trees increased after community intervention. This might be mainly because of control of grazing and forest fire and plantation and protection of forest.

4.4 Changes on bird's diversity

Table 4 compares result of this year (2015) bird survey with year 2012 results. This year survey reported 98 species of birds in the Barandabhar corridor belonging to 12 orders and 34 families. However, year 2012 survey showed 96 bird species belonging to 34 families and 11 orders in the Barandabhar corridor. This shows that bird diversity in corridor has increased in recent year.

TABLE 3: CHANGES ON FOREST CONDITIONS BEFORE AND AFTER COMMUNITY INTERVENTION

S.N.	Particulars	Before (2009)	After (2015)	Percent Change
1	Seedlings (No/ha)	10215	20411	99.81
2	Saplings (No/ha)	1471	1695	15.23
3	Poles (No/ha)	86	220	155.81
4	Trees (No/ha)	67	78	16.41
5	Growing stock (cubic meter/ha)	134	177	32.09

TABLE 4: COMPARISON ON BIRD SURVEY RESULT WITH YEAR 2015

SN	Description	Year 2015	Year 2012	Percent change
1	Order	12	11	9.09
2	Family	34	34	0
3	Species	98	96	2.08

4.5 Changes on mammal's diversity

Table 5 compares result of this year (2015) mammal's survey with year 2012. This year survey reported 21 species of mammals in the Barandabhar corridor. However, year 2012 survey showed 24 mammals species. This shows that species richness of mammal in corridor has decreased by 12% in recent year. Mammals including *Cervus unicolor*, *Vulpes bengalensis*, *Ursus thibetan* recorded absent in 2015. This is mainly because of the east-west highway which cuts across the corridor with high volume of traffic and increase in people movement in and around forest area with the development of rural roads.

TABLE 5: COMPARISON ON MAMMAL'S SURVEY DURING 2012 AND 2015

SN	Mammal	Scientific Name	2012	2015	Remarks
1	Bengal tiger	<i>Panthera tigris tigris</i>	Present	Present	
2	One horn rhino	<i>Rhinoceros unicornis</i>	Present	Present	Decreased
3	Common leopard	<i>Panthera pardus</i>	Present	Present	
4	Small Indian mongoose	<i>Herpestes auropunctatus</i>	Present	Present	
5	Large indian civet	<i>Viverra zibetha</i>	Present	Present	
6	Hanuman langur	<i>Semenopithecus entellus</i>	Present	Present	
7	Bison/Gaur	<i>Bos gaurus</i>	Present	Present	
8	Rhesus macaque	<i>Macaca mulatta</i>	Present	Present	
9	Small indian civet	<i>Viverricula indica</i>	Present	Present	
10	Sambar deer	<i>Cervus unicolor</i>	Present	Absent	
11	Asiatic golden jackal	<i>Canis aureus</i>	Present	Present	Decreased
12	Spotted deer	<i>Axis axis</i>	Present	Present	
13	India fox	<i>Vulpes bengalensis</i>	Present	Absent	
14	Barking deer	<i>Muntiacus muntiac</i>	Present	Present	Decreased
15	Yellow throated marten	<i>Martes flavigula</i>	Present	Present	
16	Wild boar	<i>Sus scrofa</i>	Present	Present	
17	Common hare	<i>Lepus nigricollis</i>	Present	Present	
18	Jungle cat	<i>Felis chaus</i>	Present	Present	
19	Palm squirrel	<i>Funambulus pennanti</i>	Present	Present	
20	Indian smooth coated otter	<i>Leutrogale perspicillata</i>	Present	Present	
21	Sloth bear	<i>Melursus ursinus</i>	Present	Present	Decreased
22	Eurasian Otter	<i>Lutra lutra</i>	Present	Present	Decreased
23	Common mongoose	<i>Herpestes edwardsi</i>	Present	Present	
24	Asiatic Himalayan black bear	<i>Ursus thibetanus</i>	Present	Absent	

5.0 CONCLUSIONS

The study found that Community Forest User Groups (CFUGs) have adopted forest restoration approach for the conservation of biodiversity in the Barandabhar forest corridor with an aim of recovering ecological integrity and enhance human wellbeing in degraded or deforested forest. CFUGs are directly contributing in the improvement of habitat condition and forest condition, thereby facilitating appropriateness of the corridor for movement of wildlife. However, high volume of traffic in the east-west highway which cuts across the corridor and anthropogenic disturbances has obstructed the movement of the mammals in the corridor. This may threaten the appropriateness of the corridor for movement of wildlife. Hence priority should be given to minimize these threats through improving habitat connectivity and providing incentives for conservation.

6.0 RECOMMENDATIONS

The study suggested to a) Assist CFUGs to integrate biodiversity component in community forestry operational plan b) conduct detail inventories of flora and fauna including identification of rare and endemic plants (c) Conserve rare and endemic plants found, (d) Construct appropriate bio-fencing towards roadsides and settlements only (e) Strengthen capacity of CFUGs together with development of local resource person for implementing conservation program for improving biodiversity conservation in the corridor (f) Control grazing, intentional/unintentional fire, alien species invasion and promote agro-forestry practices on adjoining private and public land for maintaining and restoring habitats and (g) Design compensation programs to reimburse individuals who suffer economic losses due to wildlife depredation or damage.

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Gery-headed Canary Flycatcher by Jyotendra Jyu Thakuri

Effect of Invasive *Mikania micrantha* in Regeneration Diversity and Biological Sequestration in Kumrose Buffer Zone Community Forest: A study from central Nepal.

Sunita Ulak¹, Keshav D. Awasthi² and Dhirendra K Pradhan³

Abstract

Mikania micrantha, commonly known as mile-a minute, is one of the problematic invasive species confined in low lands of Nepal, particularly, in and around Chitwan National Park. This study assessed the alteration caused by *Mikania micrantha* on regeneration diversity, density and biological (carbon) sequestration in Kumrose Buffer zone forest. Equal numbers of sampling plots were taken in each forest blocks invaded and non-invaded by *Mikania micrantha*. The regeneration status was estimated through density and Shannon diversity indices whereas, soil organic carbon and biomass carbon stock were determined, analyzed and compared with available standard methodologies.

The regeneration density and diversity were significantly higher in non-invaded forest. Regeneration of major desirable forest species viz. *Dalbergia sissoo*, *Acacia catechu* and *Bombax ceiba* were recorded in non-invaded forest whereas regeneration of these species were absent in invaded forest. Higher regeneration diversity and density in non-invaded forest (Shannon diversity index was 1.42) shows better forest condition for growth and development of trees species than in invaded forest. Similarly, total carbon stock was 1.14 times higher in non-invaded forest indicating that *Mikania micrantha* can dramatically alter carbon sequestration. Though total carbon stock was higher in non- invaded forest, soil and undergrowth carbon stock was higher in invaded forest.

Overall findings demonstrate that *Mikania micrantha* can alter both forest regeneration and carbon storage ability of the forest. The study highly recommends concerned authorities to control further invasion of this species to conserve rich riverine forest ecosystem.

Key words: Biodiversity, Carbon Sequestration, Regeneration, *Mikania micrantha*

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1.0 INTRODUCTION

Biological diversity has become one of the most popular topics recently for discussion both in scientific and in political forum at local, national, regional and global level. Conservation of biological diversity is one of the urgent needs of the present world. Recent scientific debate has shown that invasive species, climate change and habitat loss, are the main threats to biodiversity (Monney and Hobbs, 2000).

It has been well documented that invasive alien species are the second greatest threat to biological diversity globally and the highest threat on many island ecosystems, there are also enormous economies losses incurred due to the impacts of invasive species (GISP, 2004). The Convention on Biological Diversity recognizes the importance of this global issue and calls on contracting parties to “prevent the introduction of, control or eradicate those alien species that threaten ecosystem, habitats and species” Article 8 (h). Many governments, trade sectors, international conventions and institutional instruments are recognizing the importance of this issue and are joining in the efforts with those who have already identified invasive alien species as a serious problem on various scales (Siwakoti, 2007).

Mikania micrantha H.B.K. (Asteraceae) is a perennial creeping climber of vigorous growth. It is an extremely serious weed with an exceptionally fast growth rate to 27 mm a day and it justifiably has earned the common name of mile-a minute weed (Holm *et al.*, 1977). It is native to Central and South America. It has been reported as a weed in India, Bangladesh, Sri Lanka, Mauritius, Thailand, Philippines, Malaysia, Indonesia, Papua New Guinea and many other Pacific Islands. Fallowlands, croplands, forests, shrublands and wetlands are the prominent habitat of *Mikania micrantha*. It damages or kills other plants by cutting out the light and smothering them, thus it is often known as plant killer. It also competes for water and nutrients and releases chemical substances that hinder the growth of other plants (Ye and Zhou, 2001).

Nepal is well known for its diverse flora and many plant species are endemic to country. However, alien plants have been introduced either intentionally or unintentionally for centuries and are considered as second greatest threat to native species after habitat loss. Several invasive plants including *Mikania micrantha* are listed in the ISSG (2000) list of the world's worst invasive species (Lowe *et al.*, 2000). Majority of alien plant species in Nepal are restrained to the low lands below 2000m (Shrestha, 1999 in Tiwari *et al.*, 2005). Out of 166 alien plants species naturalized in Nepal, 21 are identified as problematic. *Mikania micrantha*, is assessed as one of the six high risk posed invasive alien species (Tiwari *et al.*, 2005). It is known by the various local dialects in different parts in Nepal, such as *Panilahara*, *Birelahara*, *Titelahara*,

Bakhrelahara, *Pyangrilahara*, *Banludejhar*, *Bahramase*, *Laharabanmara* (Tiwari *et al.*, 2005). In and around Chitwan National Park, *Mikania micrantha* is found to be the most serious weed especially in riverine forest and grasslands (Chapagain, 2009).

This study focused on old plantation forest of Kumrose buffer zone community forest to add up knowledge base on the alteration caused by *Mikania micrantha* on regeneration and carbon sequestration .

2.0 MATERIALS AND METHOD

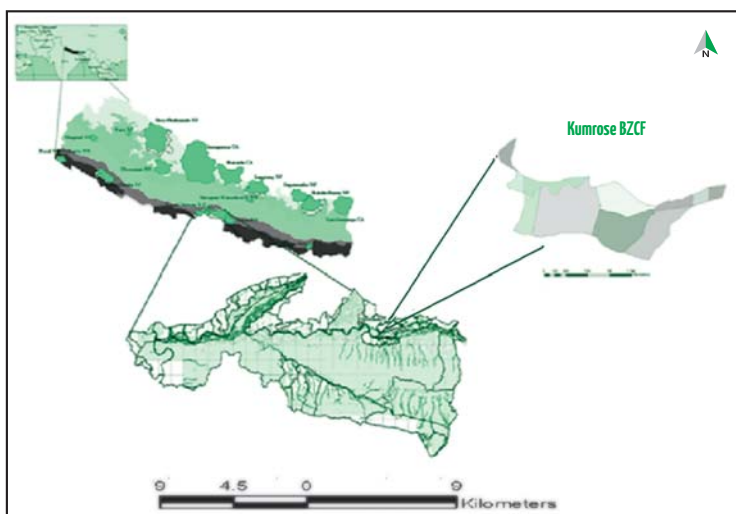
2.1 Study Area

The study was carried out in Kumrose buffer zone community forest (KBCF) of Chitwan district. The forest is situated in eastern part of Chitwan National Park and covers 1127.7 hectare in which 802.5 hectare is old plantation forest, 280.2 hectare is natural forest and 45 hectare is grasslands (BZCFOP, 2003-2008). It is a lowland riverine forest dominated by *Dalbergia siossoo*, *Acacia catechu*, *Bombax ceiba*, and *Trewia nudiflora* (BZCFOP, 2003-2008).

2.2 Data Collection and Analysis

Forest sampling and measurement

Kumrose buffer zone community forest covers 1127.7 hectare, most parts of the forest are invaded by *Mikania micrantha* and some parts are still intact. 0.25% sampling intensity was taken and overall 46 temporary nested plots were laid out following the principle of random sampling. The sample plots with invasion less than 10% or intact were considered as non-invaded whereas, invasion of more than 90% were considered as invaded. Equal numbers of sampling plots were taken in each forest blocks invaded and non-invaded by *Mikania micrantha*. Quadrates size



Map 1: Location of study area

20m x 25m for trees (>30cm diameter), 10m x 10m for poles (10-29.9cm diameter), 5m x 5m for saplings (>5cm diameter) and 1m x 1m for regenerations, grasses and herbs were laid down. Diameter and height were measured by diameter tape and Sunto clinometers respectively for all the individual stands (tree, pole), for saplings, (dbh>5cm) dbh were measured. The regenerations present within the nested plots were identified and counted. All under storey grasses, herbaceous and woody vegetation (less than 5cm dbh) were clipped and fresh weights were recorded; and a well mixed representative sub-samples were taken for oven drying. SPSS -10 was used for all statistical analysis.

Regeneration Status

Regeneration diversity and density of both invaded and non-invaded forest were compared to know the status of regeneration diversity. Shannon diversity indices equation (1) mentioned below was used to compare the regeneration diversity whereas for regeneration density equation (2) mentioned below was used.

$$H = - \sum_{i=1}^S p_i \ln(p_i) \dots\dots\dots (1)$$

Where, H is Shannon's diversity index, S is total number of species in the community, P_i is proportion of S made up of the *i*th species.

$$\text{Density (Nha}^{-1}\text{)} = \frac{\text{No of regeneration}}{\text{Area of plots}} \times 10000 \dots\dots\dots (2)$$

Above ground biomass and carbon estimation

Based on the tree height and dbh measured for individual stands, total stem volume was calculated by using following allometric equation (Sharma and Pukkala, 1990).

$$\ln(V) = a + b * \ln(\text{dbh}) + c * \ln(\text{ht}) \dots\dots\dots (3)$$

Where, V is the total stem volume with bark (m³), dbh is the diameter at the breast height (cm), ht is total tree height (m), and a, b, and c are species specific model parameters. The species-specific parameter values of model (3) are presented in Table 1.

The total stem volume obtained from model (3) was multiplied with species-specific dry wood density to get the oven dry weight of stem biomass. The biomass of branches and leaves were assumed to be 45% and 11% of the stem biomass following Sharma (2003). Samples of undergrowth vegetation (tree species with dbh<5cm, herbs, grasses and litter were oven dried at a constant temperature of 70°C until the weight of the samples became constant (MacDicken, 1997) and the final constant weight was used as dry matter content. Dry biomass was converted to C content by using default carbon fraction 0.47 (IPCC, 2006).

Aboveground Sapling Biomass (AGSB) Estimation

The following regression model was used to calculate biomass of sapling log

$$(\text{AGSB}) = a + b \log(D) \dots\dots\dots (4)$$

Where,

log = natural log
AGSB = above-ground sapling biomass in kg
a = intercept of allometric relationship for saplings
b = slope allometric relationship for saplings
D = over bark diameter at breast height in cm

Belowground Biomass estimation

The root biomass/belowground biomass of trees vary according to species, age, microclimate and soil. The estimation of aboveground biomass is relatively simple. Belowground biomass, however, can only be estimated with time-consuming methods (Pearson *et al.*, 2005). In the absence of established relationship of stem biomass with root biomass for species specific species, this study applied the relationship developed by FAO (2000) for broad leaved vegetation whereas, for pole and sapling the stem biomass was multiplied by 0.15 (Macdicken, 1997).

$$\text{BGB} = \text{Exp} [-1.0587 + 0.8836 * \text{LN}(\text{AGB})] \dots\dots\dots (5)$$

Where,

BGB = Belowground biomass,
AGB = Aboveground biomass

TABLE 1: SPECIES-SPECIFIC PARAMETER ESTIMATES FOR MODEL (3) (SHARMA AND PUKKALA, 1990)

S.N	Species	a	b	c
1	<i>Dalbergia sissoo</i>	-2.1959	1.6567	0.9899
2	<i>Acacia catechu</i>	-2.3256	1.6476	1.0552
3	<i>Bombax ceiba</i>	-2.3865	1.7414	1.0063
5	<i>Trewia nudiflora</i>	-2.4585	1.8043	0.9220

Soil sampling and estimating soil carbon content

A pit was dug at the centre of each main plot with a maximum depth of 1m for deep soils and up to bed rock for shallow soil. Soil samples were collected from 5 different horizons of 0-20cm, 20-40cm, 40-60cm, 60-80cm, and 80-100cm for carbon content analysis. Bulk density was determined by using pit method (Pearson *et al.*, 2005). A metal core ring sampler (height 9.8cm and inner diameter 3.2cm) was used to collect sample for bulk density.

The soil organic matter (SOM) content in the soil samples were estimated using Walkley and Black's wet oxidation method and converted Soil Organic Matter to Soil Organic Carbon (SOC) as described by (Page *et al.*, 1982). Total soil organic carbon was calculated using equation (6) (Awasthi *et al.*, 2005).

$$\text{SOC} = \text{Organic carbon content\%} \times \text{soil bulk density Kg/m}^3 \times \text{thickness of horizon (m)} \dots\dots (6)$$

composition of crop etc. (Chaturvedi and Khanna, 1982). In non-invaded forest significant numbers of regeneration of *Dalbergia sissoo*, *Acacia catechu* and *Bombax ceiba* were found whereas in invaded forest a small number of regeneration of *Trewia nudiflora* and *Litsea monopetala* possibly shows the ability of the species to compete with *Mikania micrantha* as compared to other species. Similarly, higher Shannon diversity index and density in non-invaded forest provide evidence that *Mikania micrantha* have negative effect on regeneration of major forest tree species. Siwakoti, 2007 also found that colonization of *Mikania micrantha* suppressed the growth of native plants and check the regenerations; similarly, Tiwari *et al.*, 2005 has mentioned that *Mikania* has become a nuisance in forest and prevent forest tree regeneration. Furthermore, higher species richness in non-invaded forest compared to invaded forest has been studied by Kaur *et al.*, 2011 and revealed similar results. The regeneration density and Shannon diversity index are presented in Table 2.

3.0 RESULTS AND DISCUSSIONS

3.1 Regeneration status in invaded and non-invaded forest

Regeneration of the species depends upon moisture, air, light, temperature, condition of competing weed growth,

TABLE 2: REGENERATION DENSITY AND SHANNON DIVERSITY OF FOREST

Species	Non-invaded		Invaded	
	Regeneration density (N ha ⁻¹)	Shannon diversity	Regeneration density (N ha ⁻¹)	Shannon diversity
<i>Dalbergia sissoo</i>	2173	1.42	0	0.67
<i>Acacia catechu</i>	434		0	
<i>Bombax ceiba</i>	869		0	
<i>Trewia nudiflora</i>	1304		869	
<i>Litsea mono petala</i>	339		434	
Total	5119		1303	

TABLE 3: SUMMARY STATISTIC OF DBH AND HEIGHT

Type	DBH(cm)			Height (m)		
	Mean	Max	Min	Mean	Max	Min
Non-invaded	22.36	47.5	10	14.4	32	3.50
Invaded	19.88	41	10	12.4	32	3.20

3.2 Carbon Stock in Vegetation

The biomass of trees varies in different plots within and between invaded and non-invaded forest because of variation in tree size as well as tree density. Presence of large trees and pole in non-invaded forest results in higher aboveground biomass follows higher carbon stock and was significantly different ($p < 0.05$). The carbon stock was $103.17 \pm 13.41 \text{ t ha}^{-1}$ (Mean \pm SE) in non-invaded forest and $77.86 \pm 6.81 \text{ t ha}^{-1}$ in invaded forest. Though, total aboveground biomass carbon was high in non-invaded forest, the undergrowth biomass carbon was higher in invaded forest (1.96 t ha^{-1}) compared to non-invaded forest (1.43 t ha^{-1}) possibly because of presence of dense *Mikania micrantha* as like a carpet on the ground surface of the forest or may be forest area with open canopy and less tree density favors *Mikania micrantha* growth. Since the aboveground biomass was high in non-invaded forest estimated belowground carbon stock was also higher in non-invaded forest ($18.59 \pm 1.89 \text{ t ha}^{-1}$) than invaded forest ($15.59 \pm 1.17 \text{ t ha}^{-1}$), though it was insignificant ($P > 0.05$). The tree and pole density was significantly higher in non-invaded forest (199 ha^{-1}) compared to invaded forest (163 ha^{-1}) furthermore the average diameter and height of the tree was also higher in non-invaded forest.

Mikania climb-up and create a dense cover on the top of canopy, and damage or kill the host plants by blocking light and smothering (Holm *et al.*, 1977) which affect the aboveground biomass and consequently biological carbon sequestration. Similarly, Tiwari *et al.*, 2005 and Siwakoti, 2007 mentioned that *Mikania* climbs over other vegetation blocking sunlight, smothering forests and prevent the growth of native plants. This study also showed that *Mikania* affect forest density as well as diameter and height as a result affects aboveground tree biomass and carbon sequestration.

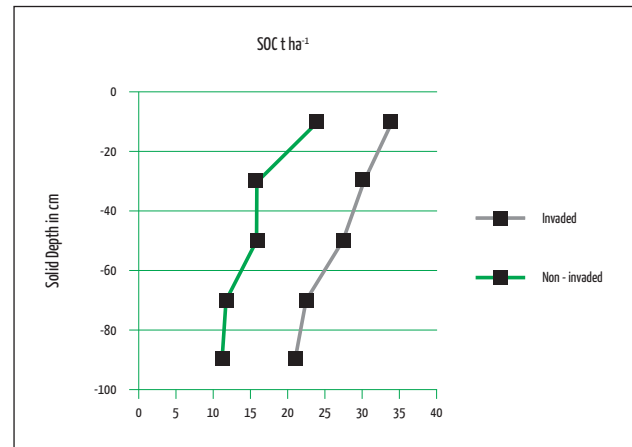


Figure 1: Soil carbon stock with respect to depth

3.3 Soil organic carbon

The mean soil organic carbon stock in invaded forest was higher and are significantly different ($P < 0.05$). Total mean soil organic carbon stock in non-invaded forest was $16.03 \pm 1.01 \text{ t ha}^{-1}$ and carbon stock in each layer of the soil were significantly different ($P < 0.05$). Similarly, mean soil organic carbon stock in invaded forest was $26.87 \pm 2.12 \text{ t ha}^{-1}$ and carbon stock in each layer of the soil were insignificant ($P > 0.05$). The invaded forest was covered by *Mikania micrantha*, which act as carpeting to the ground and each node produce root which increases the biomass in the soil, and possibly increases the soil carbon. This study revealed that *Mikania micrantha* contributes to increase carbon in the soil. In South China Chen *et al.*, 2009 also found that area infested with *Mikania micrantha* significantly contribute to soil carbon.

TABLE 4: TOTAL CARBON STOCK IN NON- INVADED AND INVADED FOREST

Level	Level categorization	Non invaded	Invaded
		OC (t ha^{-1})	O C (t ha^{-1})
Above ground biomass Organic carbon (OC)	Above ground tree biomass OC	101.75	75.90
	Under growth biomass OC	1.43	1.96
	Total Above ground (OC)	103.17	77.86
Below ground organic Carbon (OC)	Root biomass OC	18.59	15.59
	Soil OC	16.03	26.87
Total Organic Carbon (OC)		137.79	120.31

3.4 Net carbon sequestration

Total carbon stock is the sum of aboveground carbon, belowground carbon and soil organic carbon. The total carbon stock in non-invaded forest was 137.79 t ha⁻¹ whereas in invade forest 120.31 t ha⁻¹ which shows that non-invaded forest has 1.14 times higher carbon stock than in invaded forest. The carbon stock in different parts and net carbon of the forest both in non-invaded and invaded forest are shown Table 4.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The regeneration density as well as regeneration diversity in non-invaded forest was higher than in invaded forest. Aboveground organic carbon and belowground organic carbon was higher in non-invaded forest whereas undergrowth biomass organic carbon and soil organic carbon was higher in invaded forest. Though the undergrowth biomass organic carbon and soil organic carbon was higher in invaded forest, overall carbon stock was high in non-invaded forest. The study demonstrates that *Mikania micrantha* can alter both forest biodiversity and carbon storage ability of the forest. The study highly recommend concerned authorities to control further invasion of this species to conserve rich riverine forest ecosystem and research on alternate use of such species from livelihood and biodiversity conservation perspective.

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Local Level Implementing Mechanism of Payment for Watershed Services: A case of Arunkhola watershed of Dhading district, Nepal

Megh Raj Rai¹ and Rajendra K.C.²

Abstract

Payment for Watershed Services (PWS) is considered as the subset of the Payment for Environment Services (PES). The recipient of the watershed services (i.e. increased water flow, enhanced quality of the water, reduced soil erosion etc.) provide financial supports/compensation to the service providers for their contributions in the sustainable management of the watersheds.

The study was carried out with the general objective of assessing the Local Level Implementing Mechanism of Payment for Watershed Services among the major stakeholders of Arunkhola sub-watershed in Dhading. The study was carried out in 8 wards of then Nilkantha, Sunaula Bazar and Khalte VDCs with the area of 17.36 km². A total of 109 households (4.5%) were sampled for the collection of data. Relevant data were collected through household survey, key informant interview, focus group discussion, direct site observation and extensive literature review. The Contingent Valuation Method (CVM) was used to know the perceptions of the upstream and downstream inhabitants about the Willing To Accept (WTA) and Willing To Pay (WTP) of the respective communities.

It was found that downstream inhabitants have been using various types of watershed services such as municipal drinking water, irrigation, water mill operation, household uses and hydropower generation from the Arunkhola. Various direct and indirect supports were provided to upland communities from lowland communities. However, there was the prevalence of the grievances and poor collaboration between them. Very limited interactions, coordination, and regulatory mechanisms do exist due to the informal and adhoc set of the PWS mechanism in the study area. It is stressed for well established mechanism of PWS for sustainable management of upstream watershed resources and rational use, establishment of functional watershed level council of service providers, solely responsible for the management and negotiation with service recipient.

Key words: Environment Services, Community Forest, Payment for Watershed Services

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1.0 BACKGROUND

Ecosystem Services (ES) means any benefits that people obtain from ecosystem conservations, such as drinking water, hydropower, biodiversity and carbon sequestration. Payment for Ecosystem Services (PES) involves transfer of financial resources from beneficiaries of certain environmental services to those who provide these services or holds the entitlement (Mayrand and Paquin, 2004). Wunder (2005) broadly identified four concurrent PES categories in the world: (i) Carbon sequestration and storage (ii) Biodiversity conservation (iii) Watershed protection, and (iv) Landscape. Payment of Watershed Services (PWS), a subset of PES, appears to have the potential to improve resource management and fulfill the needs of the people from both upstream and downstream perspectives. It is also seen as an instrument for promoting conservation and reduces rural poverty. Different localized PES schemes are already being practiced in Nepal and are mostly focused on use regulations but these schemes grossly ignore the key elements of PES (IUCN, 2013b). PES-PWS could help to alert societies on deterioration of the ecosystem that generate them (Costanza *et. al.*, 1997).

About a dozen of PES schemes have been successfully implemented in Shivapuri, Kulekhani, Rupa lake, Dhulikhel, Dolakha and Kanchanpur in Nepal (WTLCP, 2012). Meanwhile the Ministry of Forest and Soil Conservation (MoFSC, 2014), through Forest Policy 2015, emphasizes on the strengthening of the PES/PWS to leverage funds as a potential viable approach for Nepal. It also emphasizes on the need for more action oriented piloting. In this context, the study attempts to evaluate the watershed resources, ecosystem services, local institutions and use of environment services in Arunkhola sub-watershed at Dhading and has recommended applicable PWS mechanism over there.

There are various malpractices such as cultivation in higher sloppy areas and marginal lands, over grazing in most of the areas, repeated forest fire, unplanned development activities and lack of water management regime. These have been threatening perpetual supply of quality and quantity of water from the upstream of Arunkhola watershed, against the ever increased water demand from downstream, district. Thus, this study aims at evaluating the watershed services of Arunkhola and help to develops effective local mechanism of PWS based on the actual practices, prevailing legislation and stakeholders' perception.

2.0 RESEARCH OBJECTIVES

The main objective of this study was to find out the local level implementing mechanism of payment for watershed services among the major stakeholders of Arunkhola watershed. The specific objectives are to assess and evaluate the current land use practices in upstream level, to assess the watershed services being used by the downstream inhabitants and other institutions, to

assess the existing watershed services, and to find out the applicable mechanism of Payment for Watershed Services.

3.0 RESEARCH METHODOLOGY

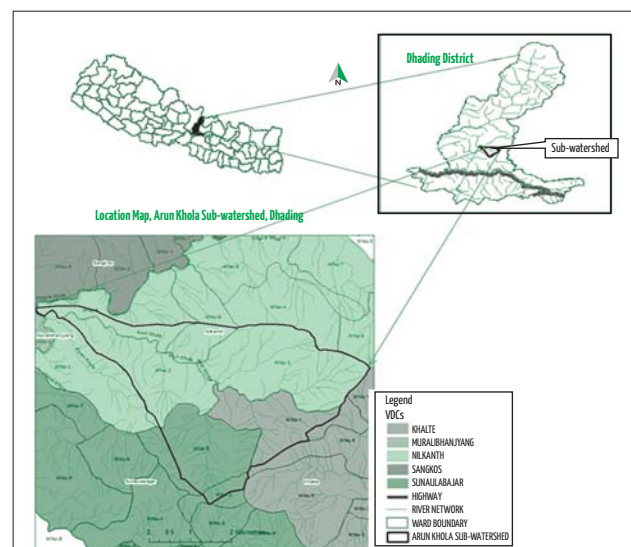
3.1 Study Area

The study was conducted in all clusters of the Arunkhola watershed area of Dhading district, which lies in the 8 wards of 3 VDCs. The total numbers of 2436 households residing in watershed were considered as population of the study. Arunkhola watershed in Dadhing district of Central Development Region of Nepal was selected for this study due to the following reasons:

- The only watershed of the district from where multipurpose use of watershed resources for many decades.
- There is hot debate and conflicts between upstream and downstream dwellers for water use and compensation.

3.2 Research Design

The study was mainly based on descriptive research design. This method of research design, observing and describing the upstream-downstream relationship for the benefit and cost sharing of the conservation without influencing, are applied. Additionally, this study collected quantitative information from the study area. Contingent Valuation Method (CVM) was applied to measure the value of watershed resources (Ciriacy-Wantrup, 1947). Both biophysical characteristics and social aspirations were studied.



Map 1: Map of study area

Muti-stage random sampling was used for collecting data. The sampling strata were formed based on the ward, caste and ethnicity, mode of land management (Government managed forest/Community forest/Leasehold forest) including men and women. Number of sample size was allocated purposively to both upstream and downstream areas. A total of 4.48% population was selected for the study. The size of the sample has been determined by applying Cochran's sample size calculation formula (Cochran, 1977). A total of 109 households, considering caste and ethnicity, were selected proportionally from the upstream and downstream areas. Relevant data/information was collected through primary and secondary sources. Primary data were collected through questionnaire survey, focus group discussion, direct observation, key informant interview and stakeholders' workshop. Likewise, secondary data were collected from literature review and existing records of the various stakeholders.

3.3 Sample household selection with Multistage Sampling cum Random Sampling.

Calculation of Ecological Value (Goods and Services) of the Forest

Ecological goods and services are the benefits arising from the ecological functions of healthy ecosystems. Such benefits accrue to all living creatures, including animals and plants, rather than to humans alone. However, there is a growing recognition of the importance to society that ecological goods and services provide for health, social, cultural, and economic needs. Change in forest cover is the major phenomena of the sub-watershed and it has evaluated on the basis of the report of Economic Valuation of Ecological Goods and Services (MoFSC, 2005).

Estimation of Soil Loss in Different Land-use System of the Study Area

Land use and management influence the magnitude of the soil loss. Various land use patterns including soil properties, rainfall intensity, and land terrain are the major determinants of the soil erosion. It depends on the site specific of the country. Here, soil loss in the Arunkhola sub-watershed is estimated on the basis of Environmental Statistics of Nepal (CBS, 2008).

4.0 RESULT AND DISCUSSION

4.1 General Information on respondents

Districts' headquarter Dhading besī of the Dhading district lies within the Arunkhola sub-watershed. There are 11,888 population with 2,436 households residing in the sub-watershed (CBS, 2011). The population density is 684.77 people per square kilometre, which is very high than national figure.

Characteristics of respondents are important for

generalizing and comparing of information obtained from them. Most of the respondents' occupation was small businesses. The respondents represent proportionately the upstream and downstream and all major caste/ethnic groups in the study area. Ethnic group like Gurung, Magar, Newar and Tamang are dominant caste of the watershed. Brahmin and Chhetri are the second largest population, which constitutes 744 households within watershed area. Small portion of the households are so called dalit. Ethnic community, Brahmin and Chhetri and Dalit are very well represented in the sampling.

- There were 61 male and 48 female respondents in the sample. Among them, 84 respondents were literates and 25 were illiterates.
- In the upstream area, only 38% local people have enough food for year round from their farm cultivation.
- More than 90% people used fuel-wood for cooking and preparing cattle feeds.
- During the crop cultivation and vegetable farming, almost all farmers used chemical fertilizer and pesticides/insecticides on their farm.

4.2 Information on Study Area

Arunkhola sub-watershed lies in mid-hill in Dhading District. This sub-watershed located in 27° 52' 9.40" N to 27° 54' 44.58" N latitude and from 84° 52' 55.80" E to 84° 57' 50.74" E longitude. The districts' headquarter Dhadingbesi lies at the downstream of this sub-watershed.

Arunkhola sub-watershed covers 17.36 square kilometres (km²) and drains out west side through Dhadingbesi (DSCO, 2013). There are nineteen community forests covering 821.9 ha area and three leasehold forests (LHF) spaced out 12 ha handed over to the local (DFO, 2013). The Dhadingbesi Small Town Drinking Water Supply Project was completed and handed over to Dhadingbesi Water and Sanitation User Committee (DWSUC) at district headquarters in 1999. These days, 1908 households are using 1.3 million litre water per day from this scheme (WSSDO, 2013). Likewise, Thopalkhola Small Hydroelectricity Project (1.65 MW) is being operated in Thopalkhola (Arunkhola is a tributary among four small river) some 12 km below from Dhadingbesi. Besides, more than one dozen small irrigation canals including two water mills (for grain husking, grinding and cooking oil production) are in operation till date (CSIO, 2013). Arunkhola sub-watershed covers total 8 wards of then Khalte, Sunaula Bazar and Nilkantha Village Development Committees (VDCs) now changed to Nilkantha Municipality in July 2014.

4.3 Land-use System of the Arunkhola Sub-watershed

Arc GIS 9.3 (Geographic Information System) software was used to identify the trends of changes in land use scenario of the Arunkhola sub-watershed between 1995 and 2010.

Forest cover is dominant within the watershed (55.62%)

and cultivation area occupies about 43.82% of the total area. Grass land and water body constitutes small portion of the area (0.56%). Forest cover, agriculture land and settlements are intermingled within the watershed. The proportion of land use system is shown in map 2 and table 1.

TABLE 1: LAND-USE SYSTEM OF ARUNKHOLA SUB-WATERSHED

No	Landuse	Area (ha)	% Coverage
1	Cultivation	761.13	43.82
2	Forest	966.07	55.62
3	Grassland	9.50	0.55
4	Water body	0.25	0.01
	Total	1736.96	100.00

(Source: Modified from DoS, 1995)

4.4 Current Land Use Practices in the Upstream

Community Forest and Pro-poor Leasehold Forest

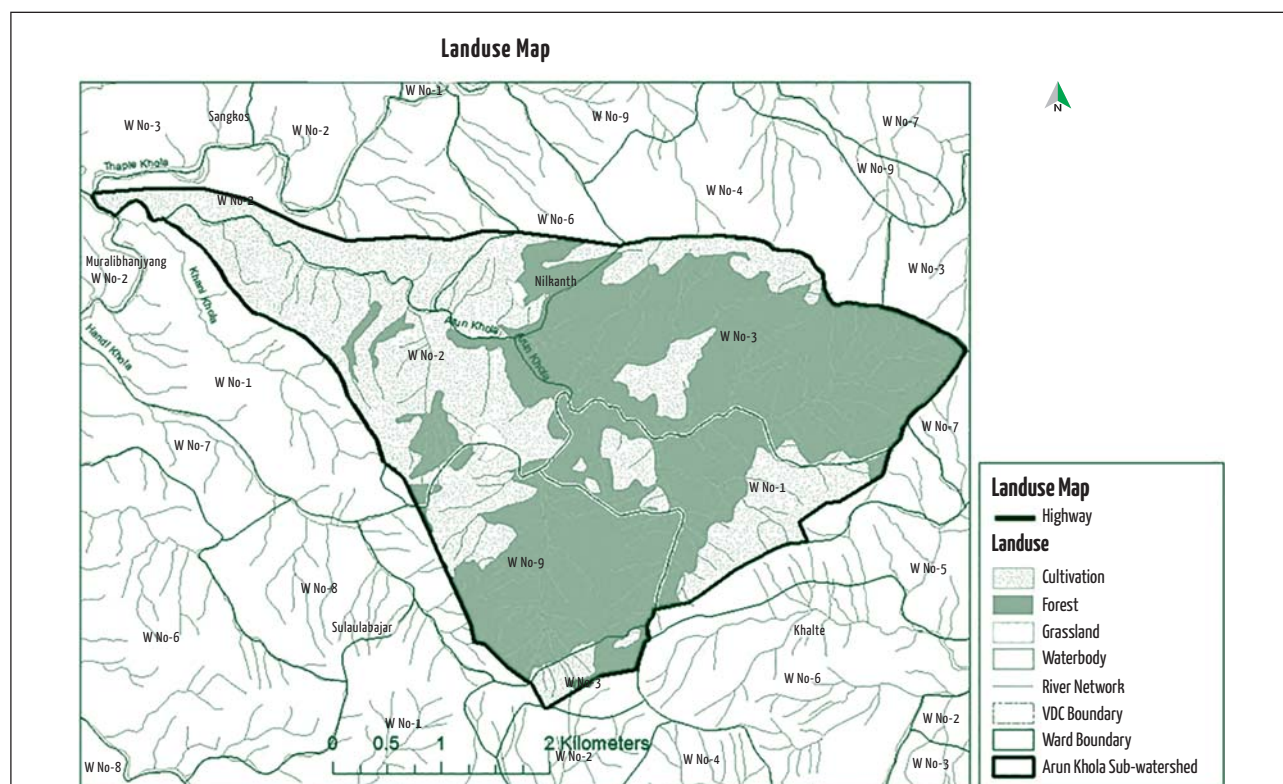
There are 19 community forests and three Pro-poor leasehold forests handed over to the local community within the sub-watershed. Local communities are managing these forests according to the terms and conditions of the

agreement with District Forest Office (DFO), Dhading. It has certainly help to enhance watershed condition.

Forest Area Loss and their Ecological Value

There was the substantial loss of the forest area in last decade. The detail of the forest area conversion is shown in table 2 and map 3. The calculation of the ecological loss in value is estimated based on the report of Ecological Value of the Goods and Services produced by Ministry of Forest and Soil Conservation in 2005, discounted at the rate of 8.64% (NRB, 2006-2015). Net present value of otal economic value of Rs. 11.5 million has been loss due to the deforestation of the 107.88 ha in between 1995 and 2012. The ecological valuation of the forest area loss is given in table 3.

It is clear that black part in the map is forest loss or conversion of forest land into non-forest land and green colour shows the forest gain of restoration of forest in other than non-forest area during 1995 to 2010. During this period, total 107.88 ha forest was lost due to different reasons.



Map 2: Land-use Map of Arunkhola Sub-watershed (Source: Modified from DoS, 1995)

TABLE 2: CHANGE IN LAND-USE IN ARUNKHOLA SUB-WATERSHED

Landuse	Area (Ha) in 1996	Area in %	Area (Ha) in 2010	Area in %	Change %	Forest Gain (Ha)	Forest Loss (Ha)	Net Gain/ Loss(Ha)
Forest	970.06	55.85	862.18	49.64	-6.21	+55.24	-163.12	-107.88
Non-Forest	766.90	44.15	874.78	50.36	6.21			
Grand Total	1736.96	100.00	1736.96	100.00				

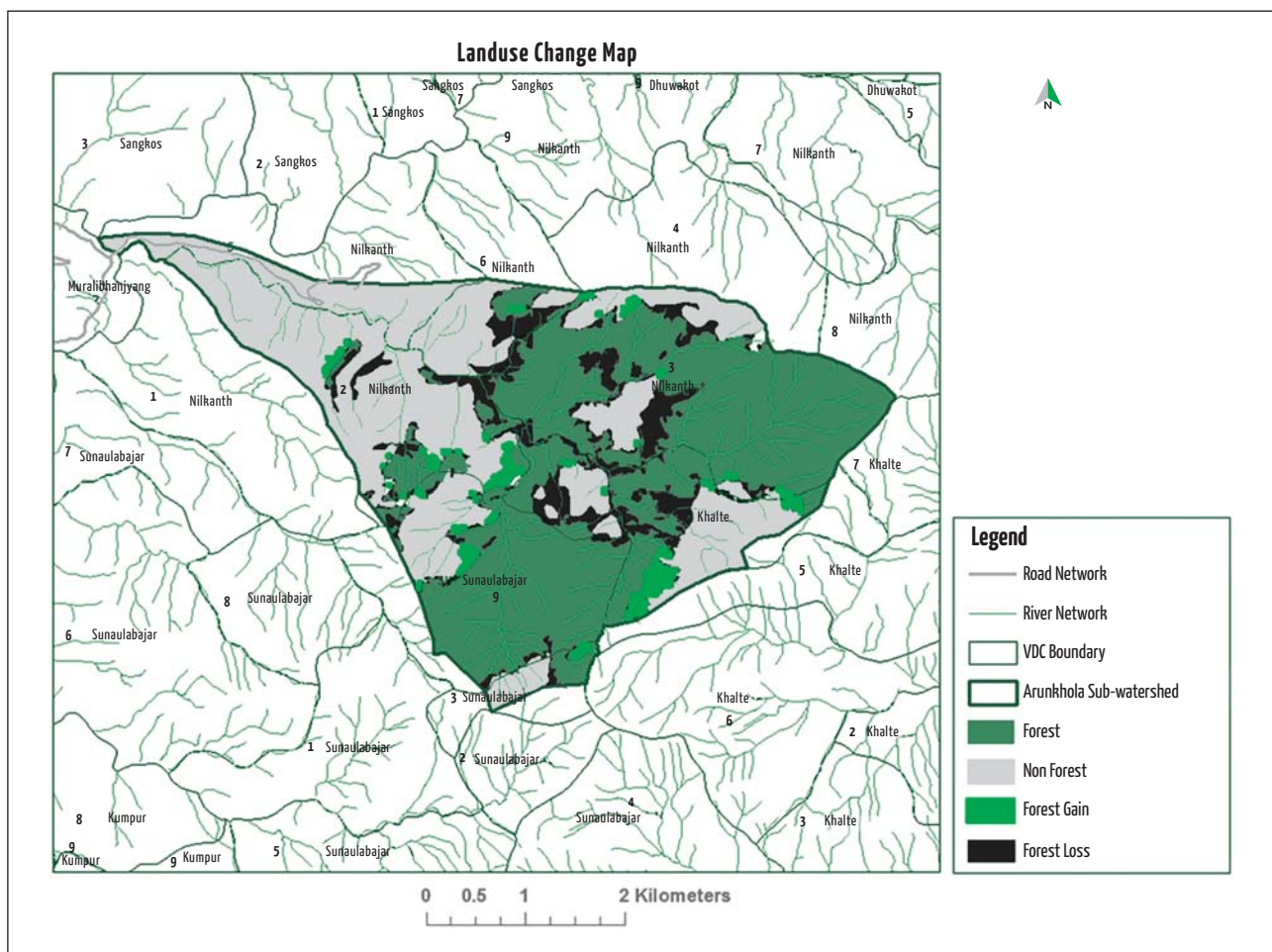
(Source: Modified from DoS, 1995 and FRA, 2012)

TABLE 3: TOTAL ECOLOGICAL VALUE OF THE GOODS AND SERVICES OF THE ARUNKHOLA SUB-WATERSHED

SN	Forest category	Direct value / ha (in \$)	Indirect value per ha (in \$)	Total Value/ ha (in \$)	Forest lost of Arunk- hola Sub-watershed Area(1995-2010)	Total lost val- ue (in \$)
1	Pine Forest of the mid hill	2109.72	2287.35	4397.08	107.88	474357.16
Net present value for 2015 at the rate of 8.64% inflation rate						1086277.90

(Source: Calculated from MoFSC, 2005)

Note: One \$ equivalent to 105.88 Nepali rupees at October, 2015.



Map 3: Land-use Map of Arunkhola Sub-watershed (Source: Modified from DoS, 1995 and DFRS, 2012).

Estimated Annual Soil Loss from Arunkhola Sub-watershed

Present land use information has been drawn from Forest Resources Assessment Report 2014 (FRA, 2014). In this information, land category is divided only in forest and non-forest area. Degraded forest also includes non-forest area. The soil loss is estimated in mid value of the given range for the degraded forest and agriculture land and while calculation for dense forest, mean value of lower limit of degraded forest and agriculture land and dense forest value is taken into account. In this way, it is estimated that about 92040.44 tons of soil is moving out per year from Arunkhola sub-watershed area as shown in table 4.

4.5 Watershed Services being used by Downstream Inhabitants and other Institutions

Arunkhola sub-watershed is the main sources of drinking water for Dhadingbesi bazar and more than two dozens of small irrigation systems for the vicinity farms. Different types of ES are being used in downstream since many decades.

Dhadingbesi Drinking Water Schemes

Dhadingbesi drinking water supply scheme was started from 1978 and completed in 1981. The main source was at Jhyapukhola, which lies in Nilkantha -6, about seven kilometres far from the Dhadingbesi and reserve tank was constructed in Dandagaun, in the upper side of the market. At that time, there were only 125 taps and about 300,000 litres of water were distributed daily.

In the next phase, other 200 and 500 taps were distributed in 1994 to 1998 respectively. In 1998, 100,000 litres and in year 2000, 150000 litres more water added daily in Dandagaun reserved tank. The scheme was formally handed over to the Dhadingbesi Water Supply and Sanitation User Committee (DWSUC) in 1999. Other source was also used to bring water from Tindovane-Satmule, which lies in Nilkantha VDC-3, Kerabari in 2000. Nowadays daily water supply reached up to 1.3 million litres and 1908 taps are distributed to the users within municipal area. DWSUC receives service fee and manage all water supply systems. About NRs. 546,840 is collected on each month.

Irrigation System of Arunkhola Sub-watershed

There are 26 small irrigation systems measured during 1989-90 by Dhading District Development Project (DDDP). But all these systems are not operating systematically because of the too much water. The water user committee are also not formed yet in any system.

Status of Water Mill in Arunkhola

Water mill is an improved type of milling system of traditional grinding mill (Panighatta). There were five water mills in Arunkhola watershed area but only two mills are providing services. Actually, such type of mill is used to husking rice, grinding grains and making cooking oil. Two persons are fully employed in this mill and yearly income is about NRs 250,000. Mill owner should pay tax NRs 1200 in every three year to the Cottage and Small Industry Development Committee Office but no provision of ecosystem service tax.

TABLE 4: TOTAL ANNUAL SOIL LOSS FROM ARUNKHOLA SUB-WATERSHED AREA

Land category	Erosion rate: ton/km ² /yr	ton/ha/yr	Arunkhola Sub-watershed area 2010	Land category %	Estimated soil erosion from Arun Sub-Watershed ton/year	Soil loss percentage
Degraded forest and Agriculture land	3150-14000 (Mid value: 8575)	85.75	874.78	50.36	75012.39	81.50
Dense forest	800 (Mid value of degraded forest, 3150 and dense forest, 800 is 1975)	19.75	862.18	49.64	17028.06	18.50
Total			1736.96	100	92040.44	100

Source: Modified from WECS & CBS, 1995

Thopalkhola Small Hydropower Project, Dhading

Thopalkhola small hydropower project has been operating about 12 kilometre away from Dahdingbesi. Its intake is in Nalang VDC and power house is in Salang VDC. It is run-off-river type of hydropower scheme, established in 2005 and commercial operation was started from 2007. Its installed capacity is 1650 KW (1.65 Mega Watt).

Initial investment of the project is \$ 3.03 millions. Mean annual discharge of the Thopalkhola is 14.78 m³/s and designed discharge is 3.86 m³/s (canal water discharge). This project pay tax to Nepal Government NRs. 0.7 million/year but there is not any provision of ecosystem service fee.

4.6 Existing Watershed Services of the Arunkhola and their Monetary Values

Hypothetical price options were prepared and asked to downstream dwellers for Willing To Pay (WTP) and for upstream dwellers for Willing To Accept (WTA). Most of the respondents both from upstream and downstream were very interested in drinking water supply system. Differences between WTA and WTP were analysed by Z-test.

Mean cost of WTP (\$ 0.142) for per 10,000 litres water is greater than the mean cost (\$ 0.052) WTA. Downstream respondents (\$ 0.142) are willing to pay that cost for regular supply of drinking water for 10,000 litres. Current water supply system is very cheap, reliable, potable and based on gravity system, that are the reason why service user ready to pay more amount than service provider.

In the same way, peoples' perceptions about WTP and WTA were assessed and were analysed by Z-test of irrigation service, water mill operation and hydropower generation project. There were not significant differences

between WTP and WTA for all stated PWS and both service provider and recipient were ready to involve in PWS mechanism.

4.7 Prevailing PWS in Arunkhola Sub-watershed

There are still hot debate between upstream dweller and DDWSUC about water use and compensation. Local people blamed that their water is being used by downstream dwellers without cost while DDWUSC accused upstream inhabitant demanding unnecessary items and disturbance in regular water supply. There is only debate in municipal drinking water supply and demand of the local people and compensatory items are given below:

- **Affected land purchase:** DDWUSC purchased 30 ropani of affected land from Jhapukhola water sources of the local people to minimize local conflict.
- **Temple Construction:** DDWUSC constructed Kerabari Satmule temple \$ 283.34 on demand of local people.
- **Rural Road Construction:** 7 km gravel road construction from Izara to Kerabari by District Development Committee (DDC) under the recommendation of DDWUSC, which was compensatory demand of the local people. Total cost of road is \$ 13222.52 . DDC Dhading contributed \$ 5666.80 and local contribution was \$ 7555.73
- **Local employment:** One local care taker has been employed according to demand of local people.
- **Construction of Local Drinking Water System:** 10 cubic meter capacity reserve tank construction and establish distribution system. \$ 4013.98 by Central Irrigation Su-Division No.-3, Dhading on recommendation of DDWUSC.
- **Latrine Construction:** DDWUSC contributed \$ 377.78 for latrine construction at Bhulbhule Ahaldanda Primary School as a compensatory program.

TABLE 5: TEST OF HYPOTHESIS WHETHER THE PWS FOR WTP AND WTA AMOUNT IS SIMILAR FOR DRINKING WATER

Perception options	Mean WTA	Mean WTP
Mean value of respondents	\$ 0.052	\$ 0.142
Test of significance of difference between two mean Test value Hypothesis Under H_0 : $\mu_1 = \mu_2$ Alternative Hypothesis H_1 : $\mu_1 \neq \mu_2$ Level of significance = 0.05 Critical value $Z_{\alpha} = 1.96$	$Z = .275$	
Inference/ decision	Since $Z > Z_{\alpha}$, null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance. That is the difference is significant.	
Confidence interval at 95% level of significance		

- **Financial Support:** Support \$ 283.34 to construct Bhulbhule Women Community Building as a compensation demand.
- **Off-season Crop Compensation:** DDWUSC start to collect extra water from Muldikhola and made agreement with local land owner to pay \$ 1416.70 per year as a compensation for off-season crop of 30 ropani fertile land in Muldihikhola, Kerabari.

5.0 CONCLUSIONS

- i Deforestation in Arunkhola sub-watershed area is 0.414% per annum, which is less than national average of the 2.3% of the hilly area of Nepal. It shows the upland resource owners have better managed the forestry resources mainly due to the community forestry management regimes.
- ii The percentage of soil loss from the arable land is about 4.5 times more than forest area of the Arunkhola sub-watershed. Therefore, the forest conservation or sustainable management could contribute better than agriculture in soil conservation, maintenance of water flow and quality.
- iii Gradual promotion of greenery, crown coverage in the upstream and decrease in stream bank cutting and silt deposition is the direct and tangible example of forest management efforts
- iv It was found that only drinking water users were involved in traditional mechanism of PWS which is not based on the principle of PES. The informal and ad hoc PWS mechanism existed in the study area. It has been less effective to manage the grievances and conflicts between upland resource owners and low land beneficiaries.
- v Although drinking water users were involved in traditional PWS mechanism but conflict was rising due to increasing new demand of service providers.
- vi Downstream respondents were Willing To Pay watershed services, if they were assured to get ES.
- vii Upstream respondents are Willing To Accept compensation for land use change, change in cropping pattern and conservation of the forest resources over there.
- viii All major stakeholders (implementing actors) internalized the PWS system. They are ready to fully facilitate for implementing this PWS mechanism.
- ix Regular supply and increase of quality and quantity of water depends on proper management of watershed which is complex and time taking process. PES/PWS alone can't satisfy the need of upstream inhabitants and it invites multi-stakeholder implementation environment.
- x There were three local government (DDC, VDC and WRC), eight CBOs and eight government line agencies working in the Arunkhola sub-watershed which were relevant to the natural resources management and PWS mechanism but they had not enough coordination, collaboration and regulatory mechanisms. A formal, legitimized and participatory PWS mechanism needs to develop for the overall

coordination, cooperation, institutionalization and regulations of the mechanisms generating sustainable services and satisfying both the owner and beneficiaries of it.

6.0 RECOMMENDATIONS

- i. PWS is emerging as a new concept in our context; it should be implemented by formulating clear policies, laws, guidelines and directives.
- ii. Independent valuation of watershed resources like biophysical, economic and social systems should be carried out for the development of PWS mechanism.
- iii. There should be a better coordination among development partners for wellbeing of both upstream and downstream people.
- iv. Local mechanism of PWS should be developed as per local situation and based on PES principle.
- v. The formal, multi-stakeholder participated, registered PWS mechanisms made of the participations of the various organizations, well set of rules, norms and values, needs to develop for real implementation of PWS. It will support to institutionalize the mechanism, develop ownership among stakeholders and better implementations.

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Brown-capped Pygmy Woodpecker by Jyotendra Jyu Thakuri

Mapping Carbon Benefits and Species Richness in Community Forestry in Nepal

Him Lal Shrestha¹, Krishna R. Dhital², Roshan M. Bajracharya³ and Bishal K. Sitaula⁴

Abstract

Nepal has implemented Community Forestry programme and achieved it as successful forest conservation program over past three and half decades. Forest acts as key factors for nature conservation and ecosystem balance which has multiple roles on habitat management of wildlife as well as it is also home-ground for ecosystem parameters. The goods and services provided from the forest to the local people and to the environment is the major part of the assessment of the forest's services. This ecosystem services focuses on the services provided by the forest entity to maintain the ecological and ecosystem balance i.e. carbon sequestration, greenery promotion, watershed functions, biodiversity conservation.

The study attempted to map the ecosystem services at five community forest from three districts namely Gorkha, Chitwan and Rasuwa, representing different geography and forest types. The method adopted for the mapping is basically field data collection and then analyzed at plot level. The analyzed data at plot level was further correlated with the remote sensing parameters viz. NDVI and geostatistical approach to extrapolate for the entire forest.

The result showed that the ecosystem services provided by forests are possible to map out at forest level and it is quantifiable with higher precision level. The study opens the door to include other ecosystem services and goods to map with the same framework which ultimately support to understand the ecosystem function of the resources. Tree parameters such as belowground biomass, soil organic carbon, presence of leaf litter-herbs-grass and total carbon are dependent factors with above ground biomass. Again species richness depends upon regeneration rate and density. The study concludes on accuracy of quantity and quality mapping of ecosystem services are higher by using remote sensing tools than the ordinal methods.

Key words: Biomass, Carbon, Species Richness, NDVI, Extrapolate, Geostatistics

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1.0 INTRODUCTION

Ecosystem services are the beneficiaries obtain by living beings from natural state of environment. This ecosystem is compiled box of plant, animals with micro and macro bodies. Millennium Ecosystem Assessment 2005 estimates that ecosystems are globally declining by 65% rate and which will negatively signifies on the human well beings (Thapa *et al.*, 2013; MEA, 2005). There are three major important characteristics of ecosystem services such assessment are ecosystem variability, resilience and thresholds. Implementation of carbon sequestration in biomass as soil through different parameters requires reliable quantification of carbon at field and watershed level (Shrestha *et al.*, 2008).

Many ecosystem services from the forest are largely unrecognized in their global importance or in the pivotal role they play in meeting needs in particular countries and regions. The availability of most of these natural ecosystem products are declining rapidly due to their habitat conversion (Daily *et al.*, 1997a). Most of these services including water supply, waste management, fisheries, natural hazard protection have been degraded over the past 50 years (UNEP, 2009).

Out of eight goals defined by United Nations Millennium development goal (MDG), seventh number goal is 'to ensure environment sustainability' which directly links up on ecosystem management and first and third goal is 'to eradicate extreme poverty and hunger and promote gender equality and women empowerment is fully achieved'. These goals can be successful only if there is sustainability in environment services. To dissolve environment degradation and ecosystem balances forest can input its great effort.

Spatial assessment and mapping of ecosystem conditions are suitable for biodiversity conservation and restoration are important for the establishment of baseline biological data that will aid in successful conservation planning and management in highly modified landscape (Baral *et al.*, 2014 page 553; Eigenbrod *et al.*, 2009; Jones-waters, 2008).

The spatial and temporal scales are useful on defining the scale domain of the process. This spatial assessment and mapping of Ecosystem Goods and Services (EGS) are considered essential prerequisites to subsequent quantification and valuation (Baral *et al.*, 2013; Burkhard *et al.*, 2010, 2012; de Groot *et al.*, 2010; Kareiva *et al.*, 2011). Importantly, spatial assessment of EGS can be helpful in visualizing pattern and distribution (Troy and Wilson, 2006), trade-offs and synergies among them in a particular landscape (Baral *et al.*, 2013; Naidoo *et al.*, 2008; Nelson *et al.*, 2009; Raudsepp-Hearne *et al.*, 2010). Ecosystem goods and services change over the space and time as a result of changing patterns of land use or changes in its composition and structure of different vegetative types. Spatio-temporal assessment of ESG can provide valuable information on the consequences of changing land use land cover for EGS and helps with this complexity (Baral *et al.*, 2013).

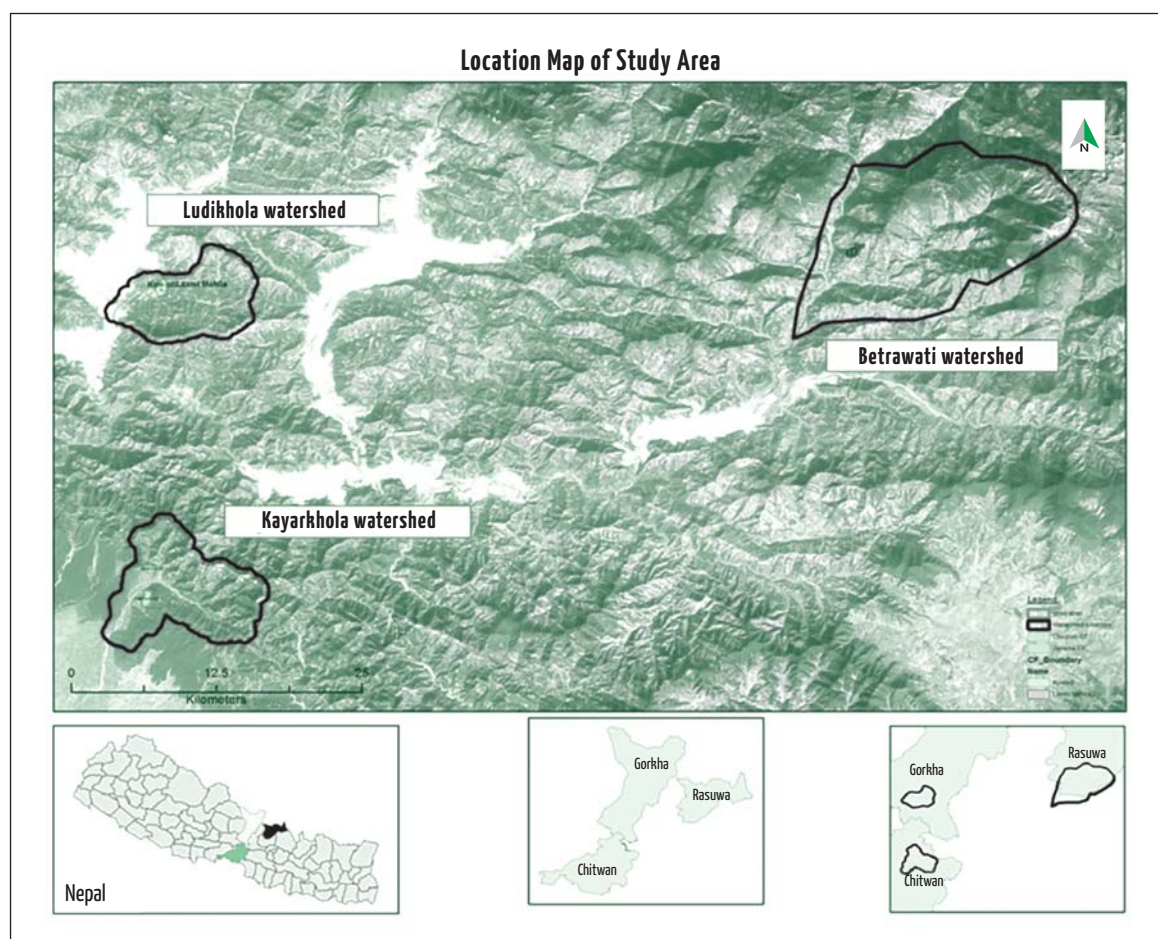
The study had attempted to map out the ecosystem services at different community forests such as above ground biomass (AGB) carbon, belowground biomass (BGB) carbon, soil organic carbon (SOC), species richness from 3 districts namely Gorkha, Chitwan and Rasuwa situated at different ecological regions and altitudinal ranges. The main objective of this study is to quantify and map out the ecosystem services provided especially from the community forests in Nepal.

2.0 STUDY AREA

Three watersheds in Rasuwa, Gorkha, and Chitwan districts of Nepal were selected for the study (shown in Map 1). These study sites fall in 3 different eco-regions among the 200 Global Eco-regions (Olson and Dinerstein, 1998). The Betrawati watershed of Rasuwa district represents the temperate forest at higher altitudes of the Mountain. The Ludikhola watershed of Gorkha district represents the mixed hill Sal (*Shorea robusta*) forest of the lower mid-hills with moderate altitude level. The Kayarkhola watershed of Chitwan district represents the low altitude forest of the foothills of Nepal dominated by *Shorea robusta* and associated species. Information on study sites at watershed and community level is also presented in Map 1 and Table 1.

TABLE 1: DESCRIPTION OF THE STUDY AREA

Watershed	User groups	Altitude (m)	Eco-region	Forest type
Kayarkhola watershed (Chitwan)	Jamuna CF Chelibeti CF	Below 500	Himalayan Sub-Tropical	Subtropical moist broadleaf forest
Ludikhola watershed (Gorkha)	Laxmi Mahila CF Kuwadi CF	500 to 1000	Himalayan Sub-Tropical	Subtropical moist broadleaf forest
Betrawati watershed (Rasuwa)	Ghaiyabari BZ CF	1000 to 1500	Eastern Himalayan	Temperate Broadleaf and mixed forest



Map 1: Location Map of Study Area

3.0 MATERIALS AND METHODS

The study was carried using secondary and primary data collected during this study. Secondary sources of data basically consists the Landsat data and other ancillary data available from the local context i.e. details about the study area. Primary data are basically collected during the field measurement on forest and soil parameters. SPSS and Excel for the statistical analysis and ArcGIS and ERDAS Imagine for the geospatial analysis of remote sensing data and mapping were used during this study.

3.1 Sampling design

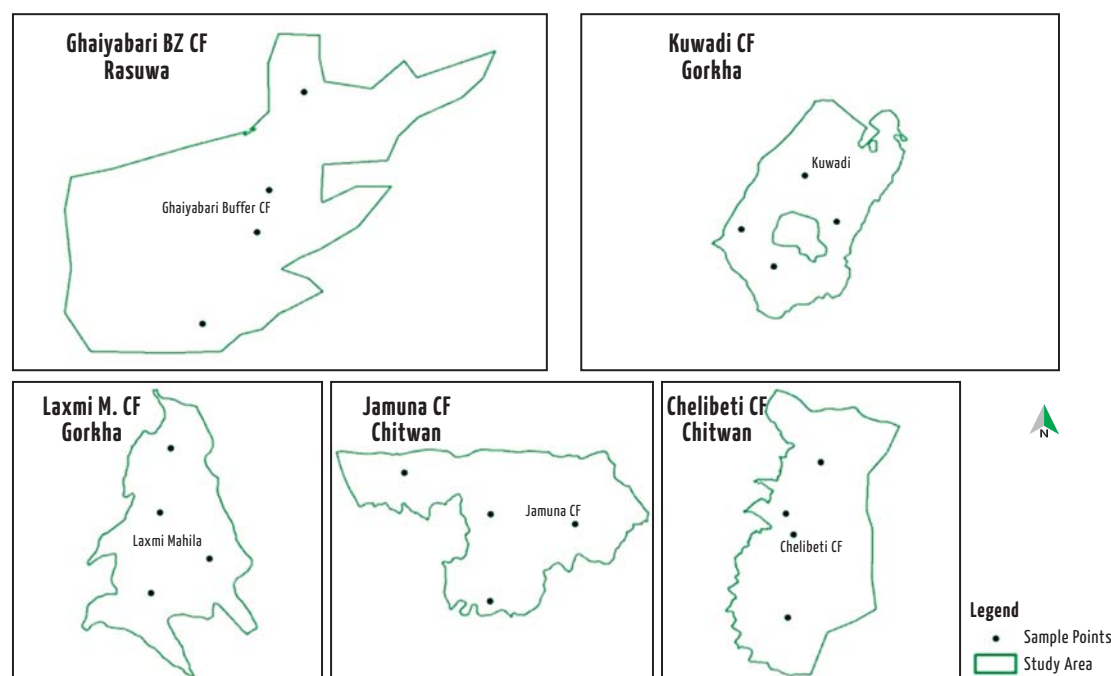
Three districts from different altitudinal regions with different ecological zones were selected. One watershed was selected in each district and altogether 5 CFUGs were selected from three districts. Each CFUG was assessed using the sampling design of 4 samples for the forest and soil enumeration (Map 2).

3.2 Plot measurement

A circular plot of 500 m² having the radius of 12.6 m was laid for the data collection in the forest (Figure 1). The forestry and soil parameters were collected from the field. Diameter at Breast Height (DBH) and Height of the trees were measured with the species identification having more than 10 cm DBH. The GPS location information, the leaf litter, grass and herbs (LHG), soil samples and regeneration count establishing 1m*1m sub-plot was taken at the center of the plot (Figure 1).

The Soil sampling was done at different possible depth up to 100 cm in the 4 depths i.e. 0-15cm, 15-30 cm, 30-60 cm and > 60 cm depth. However, due to the soil profile exist in the sampled forests, mostly soil samples were collected from the upper two depths (horizons) consistently and considered those for the further analysis.

Total samples = 5 CFUGs * 4 Replicates = 20



Map: 2 Sampling design for the study

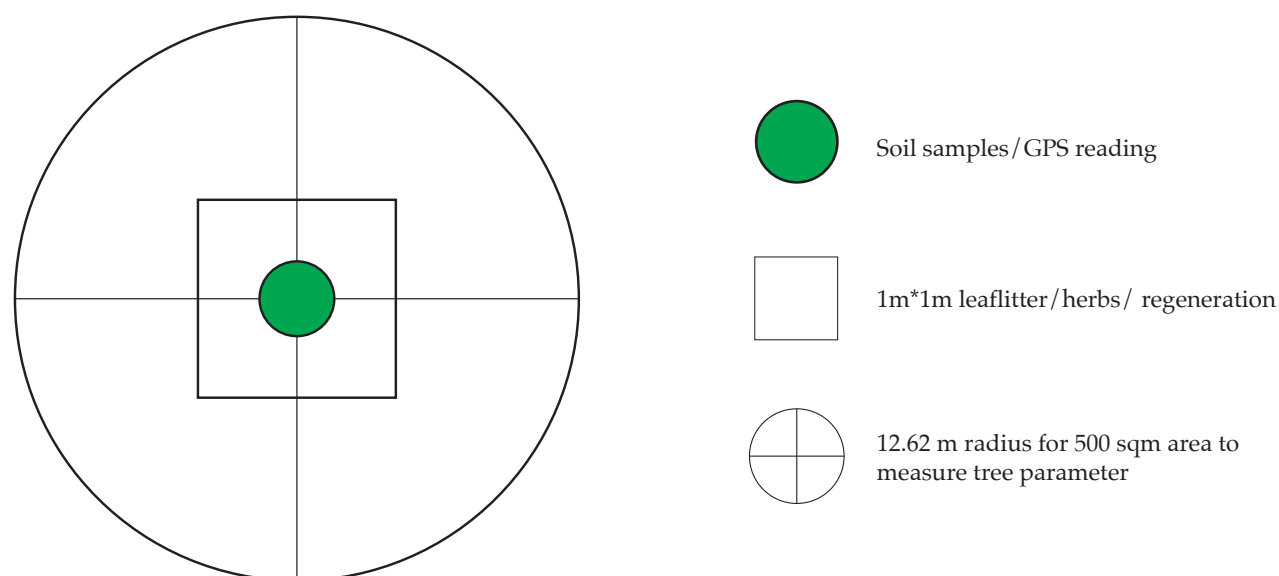


Figure 1: Sampling plot design

3.3 Laboratory analysis

LHG data and soil samples collected from the field were processed through the laboratory examination to quantify the carbon contents of LHG and soil samples at different depth. The Loss of Ignition method was adopted to quantify the carbon contents in LHG collected and Soil samples.

3.4 Statistical analysis

The statistical approach of the data extrapolation were used for the per hectare estimates for AGB, BGB, LHG, SOC, species richness and tree density. The per hectare analysis was done as follows;

$$\begin{aligned} \text{C/ha} &= \text{C} \times 500 / 10000 \text{ kg} = \text{C} / 20 \\ \text{C t/ha} &= \text{C} / (20 \times 100) \text{ t/ha} \end{aligned}$$

3.5 Extrapolation techniques

Remote Sensing

The regression analysis was done between the AGB Carbon and image indices generated from the Landsat images of the year 2010. Landsat image of the study areas were acquired from the free domain available from USGS Earth Explorer. Image indices - NDVI was calculated using the image ratioing method.

$$\text{NDVI} = (\text{IR}-\text{R})/(\text{IR}+\text{R})$$

The NDVI basically ranges from -1 to +1 value of reflectance indicating the vegetation abundance. Here NDVI is used to quantify the forest trees having carbon are significantly captured by the NDVI.

The location of the samples was later plotted after the location information captured using GPS which correlates the field samples with the image indices. The field samples plotted was later buffered with 12.6 m radius so that the polygon of 500 m² was generated in every sample. Using the buffered polygons, average NDVI were captured using spatial analyst of Arc GIS. The field calculated biomass carbon and NDVI values for each plot later correlated each other and explored the best fit equation to extrapolate the AGB Carbon for the entire forest stand.

Geostatistical analysis

Some of the parameters such as soil carbon and other parameters have limited reflectance impact on the Landsat images thus tried to extrapolate using other geospatial method i.e. Geostatistics which basically tries to use the TIN structure of the resources.

The assumption is that where the diversity increases, there will be the increase in the species richness. Species richness is a measure of the number of species found in a sample. Since the larger the sample, the more species we would expect to find, the number of species is divided by

the square root of the number of individuals in the sample. This particular measure of species richness is known as D, the Menhinick's index (Whittaker, 1977).

$$D = s/\sqrt{N}$$

Where s equals the number of different species represented in the sample, and N equals the total number of trees in the sample.

BGB carbon, LHG Carbon, and SOC are quantified using the Kriging technique of geostatistical approach.

$$\begin{aligned}\text{BGB} &= 0.2 * \text{AGB} \\ \text{SOC} &= \text{SOC}_{d1} + \text{SOC}_{d2} \\ \text{LHG} &= C_{\text{sample}} * 500/10000\end{aligned}$$

4.0 RESULTS

4.1 Field measurement

Table 2 shows over all field measurement data of different soil parameters and species richness. Different soil parameters such as AGB, BGB, SOC, LHG and Total carbon(TC) are tabulated in tons carbon per ha and species richness is in its index unit. These different parameters are analyzed by statistical approaches.

4.2 Regression relations

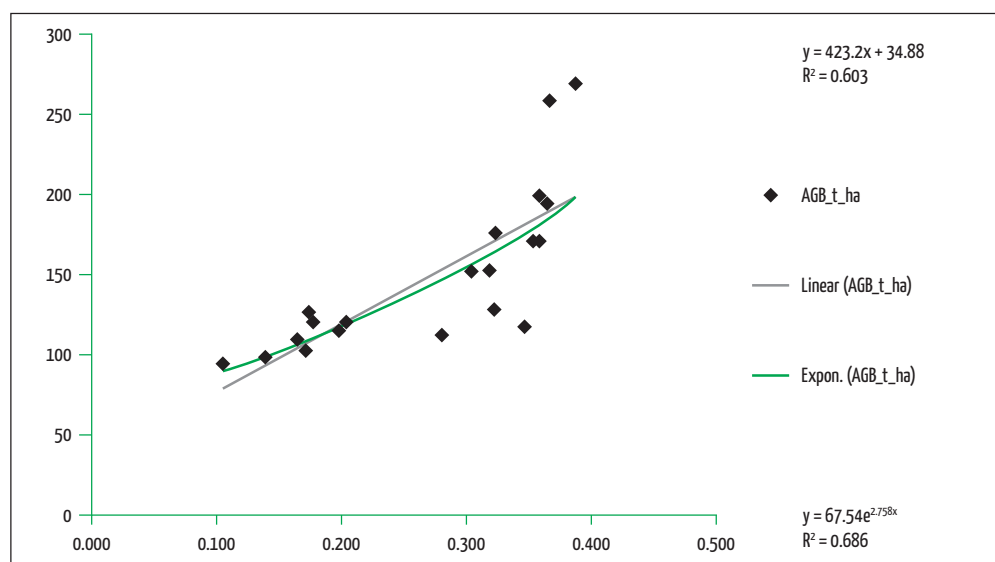
Regression relation of Above ground biomass (AGB)

The result of regression relation of AGB (in ton per hectore) was observed by using both linear and exponential relations of regression analysis. In this relation Carbon was considered to be dependent variable (y) while NDVI was considered to be independent variables (x). Linear regression was calculated by formula: $y = 423.2x + 34.88$ and exponential regression was calculated by using formula: $y = 67.54e^{2.758x}$.

TABLE 2: FIELD MEASUREMENT OF DIFFERENT PARAMETERS

CF Name	AGB*	BGB*	SOC*	LHG*	Total Carbon*	Species richness
Chelibeti	53	12	103	7	175	6.64
Jamuna	51	11	89	8	159	5.13
Kuwadi	76	17	151	18	263	5.02
Laxmi	65	14	210	17	306	3.26
Ghaiyabari	105	23	233	5	366	4.49

*Units: c t/ha



Graph 1: Regression relations of AGB (in ton per hectare)

The R^2 value of linear regression analysis of AGB Carbon was found to be 0.603. While the R^2 value of exponential regression analysis of AGB was found to be 0.686. This shows that regression relation of linear regression relation is less than exponential regression relation (Graph 1).

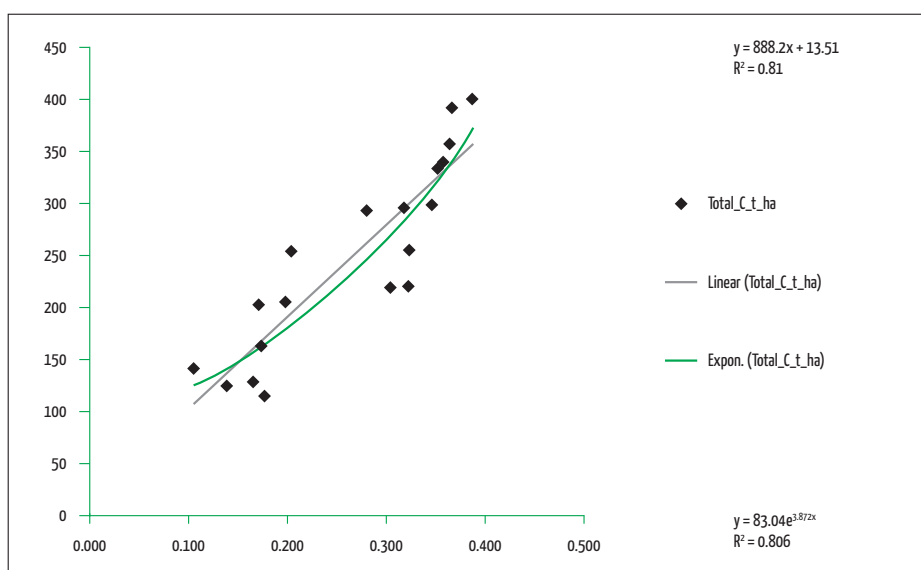
Regression relation of Total Carbon

The result of regression relation of total carbon from all study sites (unit ton per hectare) was observed by using both linear and exponential relations of regression analysis. In this relation Carbon was considered to be dependent variable(y) while NDVI was considered to be independent variables(x). Linear regression was calculated by formula: $y = 888.2x + 13.51$ and exponential regression was calculated by using formula: $y = 83.04e^{3.8722x}$.

The R^2 value of linear regression relation analysis of total carbon was found to be 0.81. While the R^2 value of exponential regression analysis of total carbon was found to be 0.806. This shows that regression relation of linear regression relation is more than exponential regression relation (Graph 2).

4.3 Geostatistical analysis

The Empirical Bayesian Kriging methods adopted for the extrapolation of other ecosystem services shows that there is possibility of mapping with the examination of Normal QQ Plot, Semi-variogram, nugget, sill and transformation parameters of the particular parameter i.e. SOC shown in Figure 2 and Graph 3.



Graph 2: Regression relations of Total Carbon ton per ha.

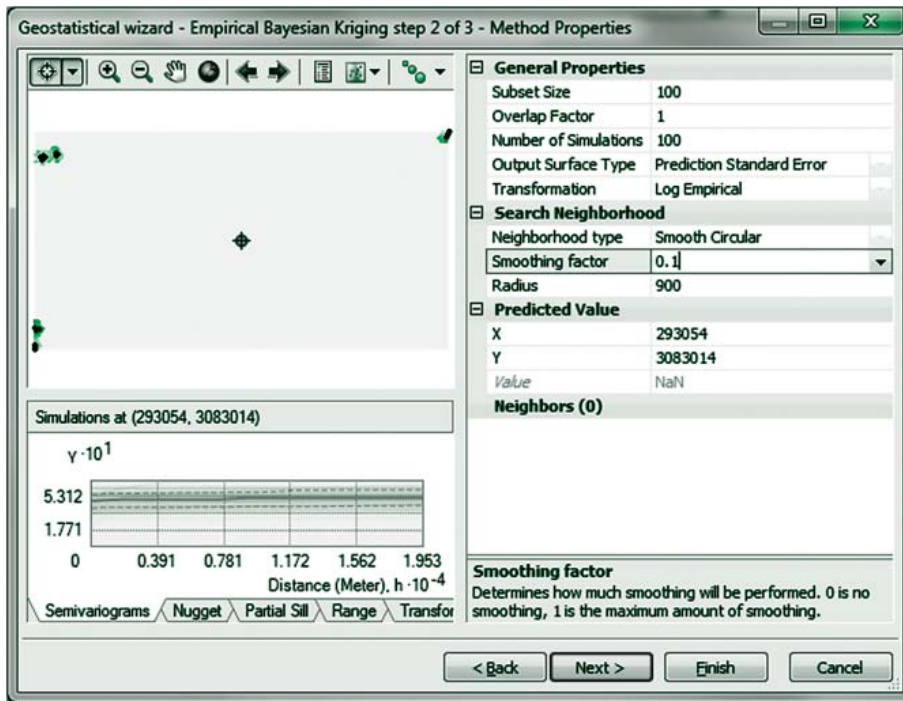
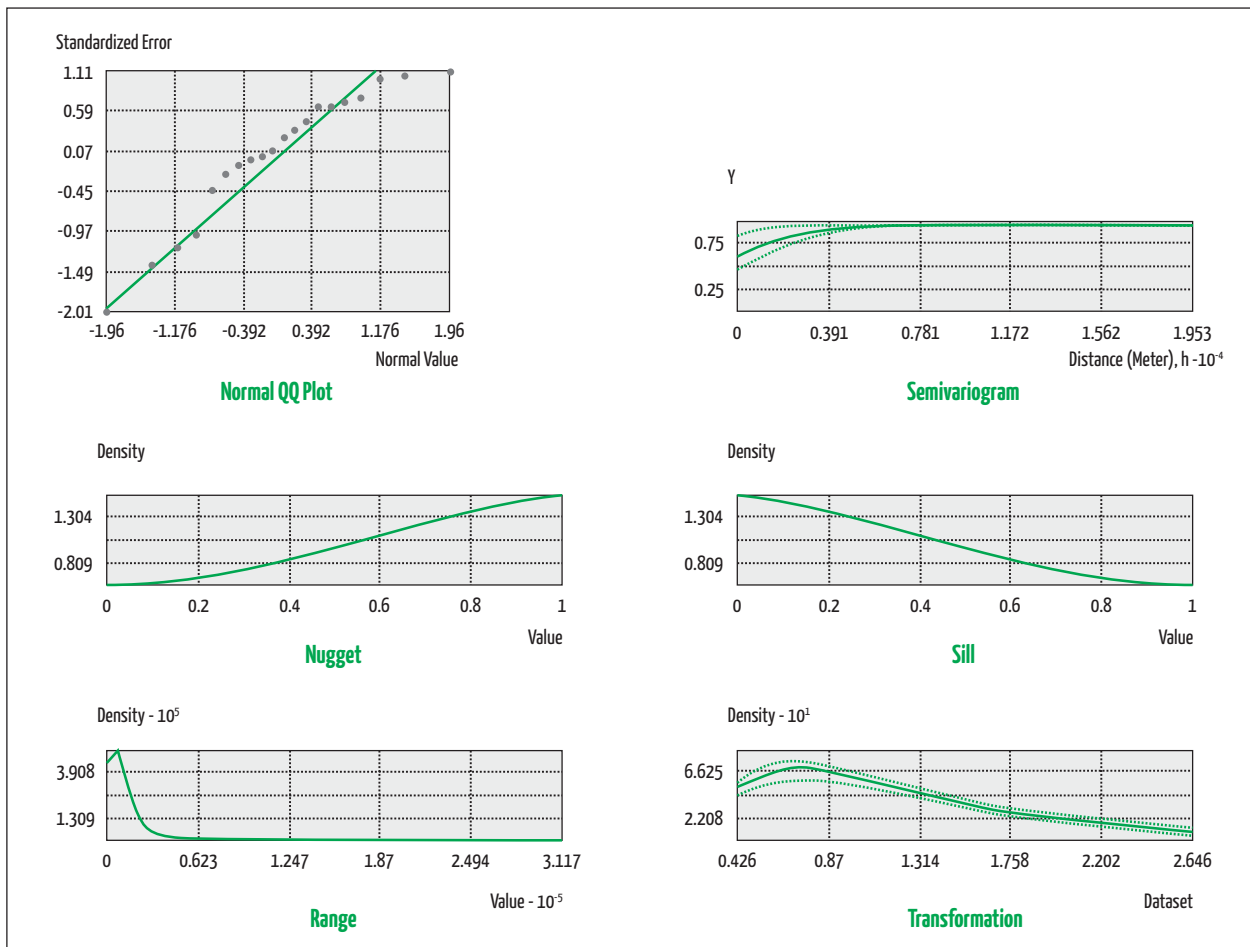


Figure 2: Windows of Empirical Bayesian Kriging



Graph 3: Different figures of the Kriging shows its ranges

4.4 Mapping of Ecosystem Services

The ecosystem services mentioned here mostly AGB, BGB, SOC, LHG and Species richness were mapped based on the analysis carried out either relation with NDVI and Geostatistical approaches.

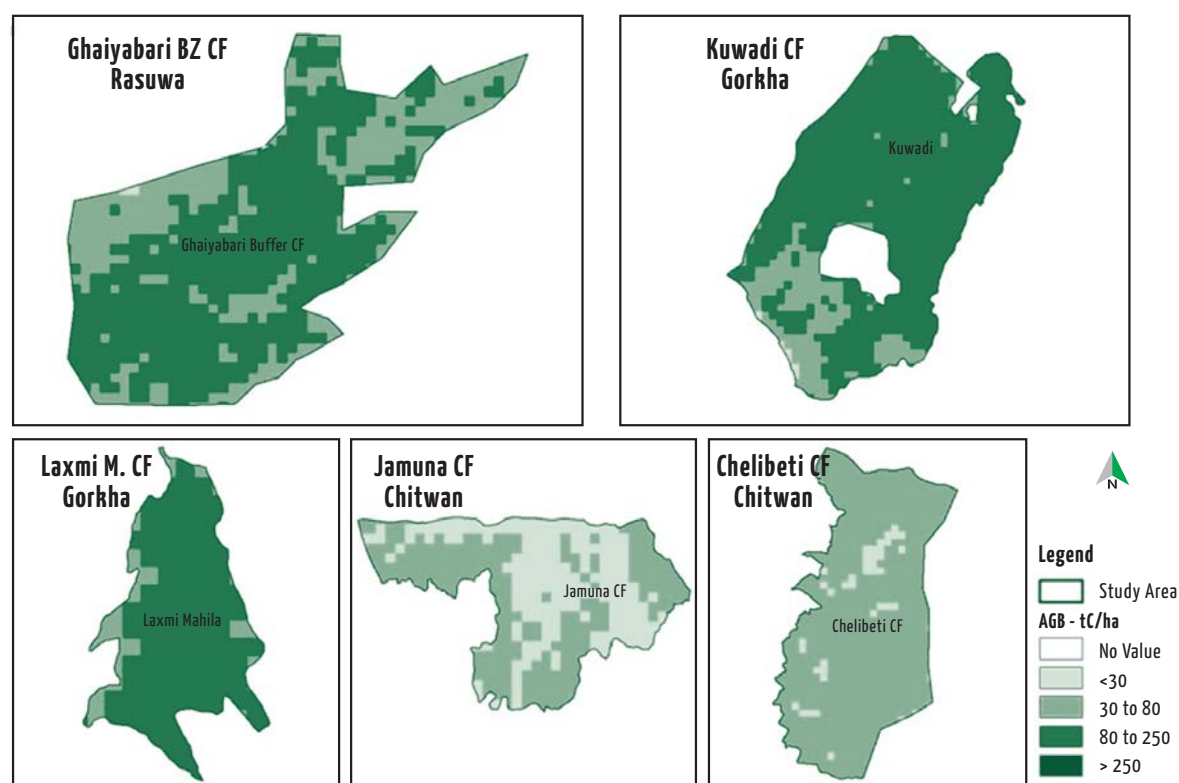
Above ground Biomass (AGB)

AGB is higher in Ghaiyabari buffer zone CF with 80 to 250 tons Carbon per ha of Rasuwa district and Jamuna CF in Kayarkhola has < 30 tons Carbon per ha of Chitwan (Map 3).

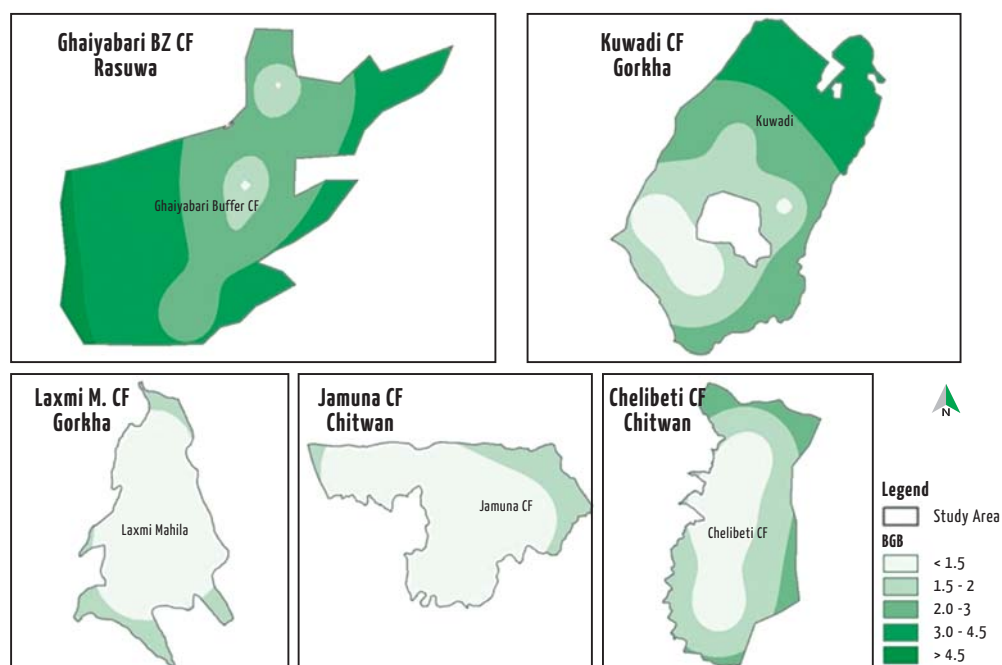
Above ground biomass of Ghaiyabari CF is highest in 105 ton carbon per hector, while Kuwadi, LaxmiMahila, Chelibeti has 76, 65, 53 tons carbon per ha respectively. Finally Jamuna CF has 51 tons carbon per ha. This shows the variation of above ground biomass with respect to decreasing geographical classification of forest type. Hence the reason behind this is due to the forest type, conservation status and timber demand.

Below Ground Biomass (BGB)

BGB is higher in Ghaiyabari buffer zone CF with 23 ton carbon per ha of Rasuwa district. Similarly it is available in Kuwadi CF with 17 ton carbon per ha and LaxmiMahila CF with 14 ton carbon per ha of Gorkha and least in Chelibeti CF with 12 and Jamuna CF with 11 ton carbon per ha of Chitwan (Map 4).



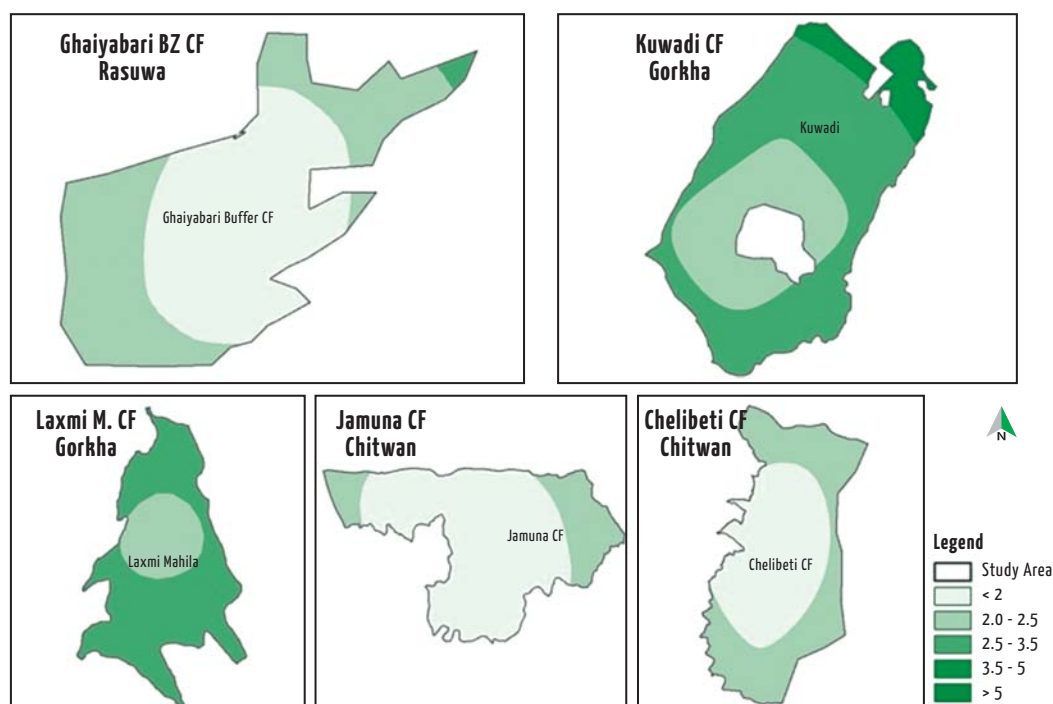
Map 3: Above ground biomass (AGB) carbon



Map 4: BGB of different Forest management

Leaf litter, Herbs and Grasses (LHG)

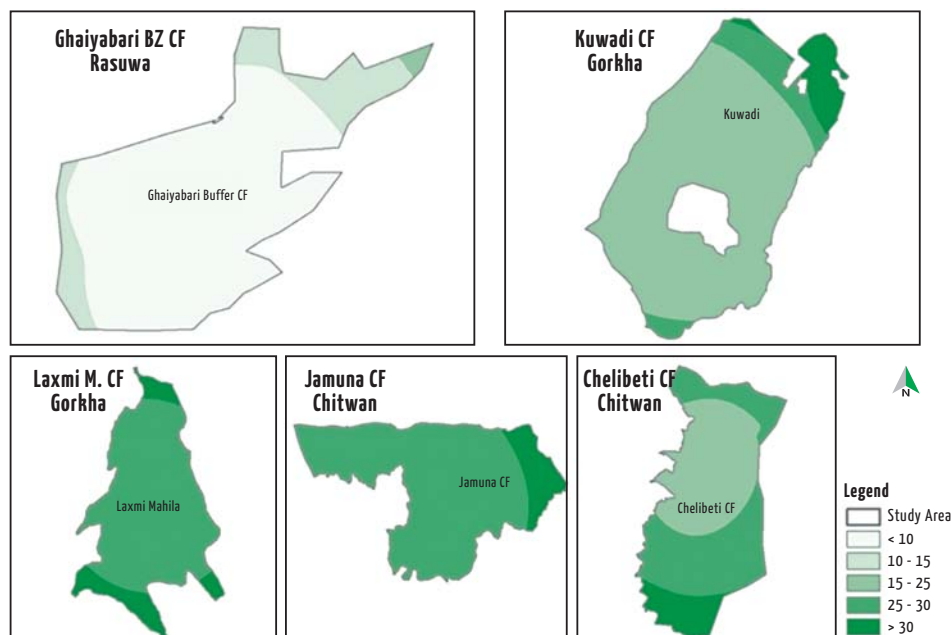
LHG composition is higher in Kuwadi CF with 18 tons carbon per ha and Laxmi Mahila with 17 tons carbon per ha of Gorkha. Similarly, Jamuna CF has 8 tons carbon per ha and Chelibeti CF has 7 tons carbon per ha of Chitwan. Least LHG is present in Ghayabari BZ CF of Rasuwawith 5 tons carbon per ha (Map 5).



Map 5: Presence of LHG in different forest management

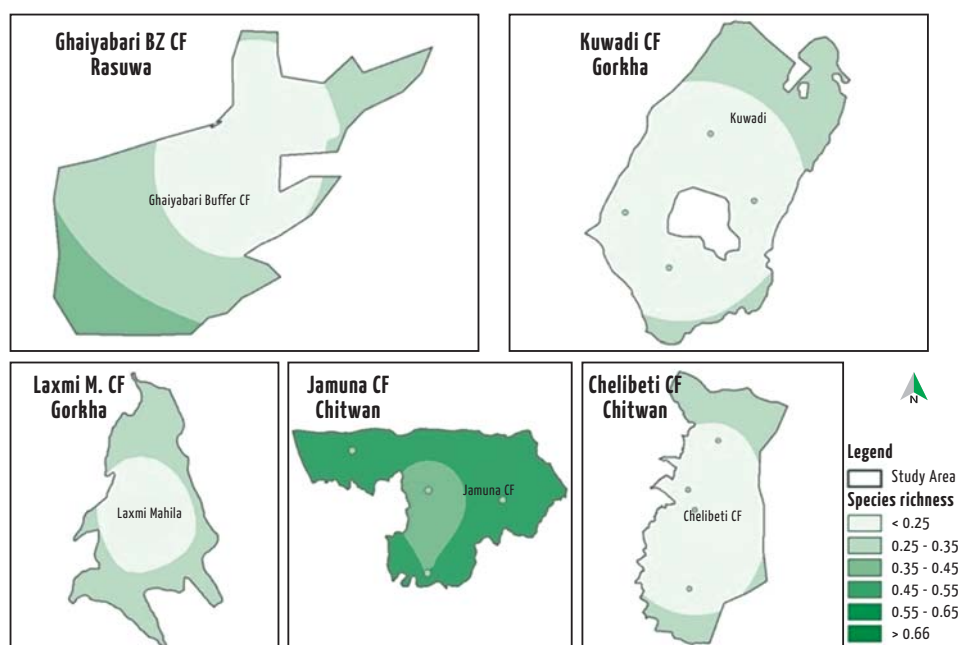
Soil Organic Carbon

SOC composition is higher in Ghayabari BZ CF of Rasuwa with 233 tons carbon per ha. Again Chelibeti CF with 103 tons carbon per ha and Jamuna CF with 89 tons carbon per ha of Chitwan, Least SOC is presented in Kuwadi CF with 18 tons carbon per ha and Laxmi Mahila CF with 17 tons carbon per ha of Gorkha (Map 6).



Map 6: SOC in different forest management

Species richness in different forest management



Map 7: Species richness in different Forest Management

The index of Species richness is higher in Chelibeti CF with 6.64 and Jamuna CF with 5.13 of Chitwan. Again Kuwadi CF of Gorkha has 5.02 index of species richness and Ghaiyabari BZ CF of Rasuwahas 4.49 index of species richness. Similarly LaxmiMahila CF of Gorkha district has 3.26 index of species richness (Map 7).

5.0 DISCUSSION

Some spatial tools such as remote sensing, geostatistical tools and GIS application are highly useful for mapping and digital interpretation on ecosystem services. Every landscape has its own variability and composition, this composition and variability cannot be interpreted accurately without using modern analytical tools. These tools help in digital mapping of a site though it will be in high quantity and quality. Such types of interpretation will be highly helpful for the relative carbon trade and RED+ implementation programme. Remote sensing NDVI tool is important to estimate above canopy biomass and other geostatistics method is important to calculate below ground soil parameters.

Community forestry in Nepal serves as good ecosystem service provider for rural households. People depend directly or indirectly for the ecosystem service providence. Some direct resource in which people depend upon services are harvesting of timber, fodder, fuelwood, surface grass, water and other resources. Similarly indirect benefit is as maintenance of climatic condition, humidity, sky rainfall, etc.

Presence of some soil parameters and biomass are judging factors forest condition. Forest at sub-tropical and lower temperate regions are nowadays changing train to be broadleaves forest to increase their biomass condition. Here from results total Carbon contains in Rasuwa district is higher than Gorkha district and then Chitwan district. This is due to diversity of decomposition rate of organic matter. As we know decomposition rate of organic matter is inversely depend upon altitudinal increment. So the higher altitudinal forest has lower carbon pools. Similarly BGB is directly proportional to AGB (canopy and stem biomass). BGB is always dependent factor to the density of AGB. Again Proportional of Leaf-Herbs-Grass is higher in Broad leaves forest of than Alpine pine needle forest, which is due to presence of scattered cone needle leaves and low regeneration at temperate region forest. Species richness at lower altitude is greater than higher altitude because of adaptation.

6.0 CONCLUSION

About forty percentage of total area of Nepal is covered with natural ecosystem. These unique landscapes are heterogeneous and its ecosystem services have important consequences for their management too. Though this study covers a small unit landscape of total ecosystem services of Nepal but outputs by spatial analysis with the figure representation will more effective for all levels of

people from which they are encouraged by seeing their outputs input variations. This spatial mapping is not only significant to local institutional level but also intensive work for policy formulation and management planning in National level.

The study concludes that Community forest has prime potential on Carbon Sequestration as in the form of inorganic (natural) to organic Carbon among different land use practices adopted in Nepal. Some of the spatial and remote sensing tools like NDVI and Geostatistics are helpful for interpreting this ecosystem services for REDD+ implementation programme. These, Natural Ecosystem services are far crucial and low cost for living being than anthropogenic developed physical services. BGB, LHG and SOC are directly related to the AGB stock in the forest. BGB is high in higher altitudinal forest while low in low altitudinal forest. This variation in presenting biomass is due to low decomposition rate in higher altitudinal forest than in tropical forest. High SOC presence in tropical broad leaves forest represents that there is high in presence of carbon humidity as well as more in organic matter. So low in Soil Organic Carbon represents low humidity presence with low micro and macro soil organic matter. LHG composition is higher in subtropical broadleaf forest than Tropical forest and then temperate forest. High LHG presence in subtropical broad leaves forest represents that good regeneration capacity with medium decomposition rate in surroundings. Similarly low LHG in Temperate forest is due to low regeneration rate, presence of pine needle species. The LHG compilation is also related to the sustainable extraction of the litter from the ground.

From the results, total carbon composition relates to above ground biomass, belowground biomass and soil organic carbon. LHG is dependent factor on decomposition rate and above ground forest species, while species richness depends upon geographical classification of forest type.

7.0 RECOMMENDATION

The findings of this study recommend strengthening national wise landscape mapping of ecosystem services by using modern technologies and derive potentials of forest management in carbon trade. And also policy lacking on mapping should be recovered as soon as possible to formulate different programme related to ecosystem services.

8.0 ACKNOWLEDGEMENT

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Participatory Biodiversity Monitoring in Community Forests: A methodological discussion based on experience of Nepal

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Abstract

Community forestry in Nepal has been widely acknowledged around the globe as a successful model of forest management that promotes conservation, management and utilization of forests generating livelihood benefits. As of September 2015, a total of 18,960 community forests users groups (CFUGs) are managing about 1.8 million ha of forest and meadows containing biodiversity hotspots (DoF, 2015). However, the biodiversity monitoring practice, doesn't necessarily cover community forests (CF), and is still limited within few protected areas (PA) that focus more on protection function and do not satisfactorily cover the issues of cost, utility and participation of local community. It does not cover those areas containing high conservation value forests located outside of PA and managed by the local people as CF.

Considering the issues and importance of biodiversity conservation outside of PA, Asia Network for Sustainable Agriculture and Bioresources (ANSAB) has designed and practiced participatory biodiversity monitoring in few community managed forests of Nepal. Building on the ANSAB's experience on participatory biodiversity monitoring, this paper discusses about methods, applications and learnings of participatory biodiversity monitoring in community forests, and highlights three major criteria of biodiversity monitoring namely i) ecosystem health and vitality, ii) anthropogenic pressure and iii) enhancing factors and numerous local indicators under each criterion. The paper concludes with a discussion about the potentiality of replication of the biodiversity monitoring in other community forests and community based forest management system.

Key words: Community Forestry, Participatory Biodiversity Monitoring, Ecosystem Health and Vitality

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1.0 INTRODUCTION

Community forestry in Nepal has been widely acknowledged as a successful model of forest management that promotes conservation, management and utilization of forests generating livelihood benefits (Timsina, 2003; Yadav *et al.*, 2003). A total of 18,960 community forests users groups (CFUGs) are managing about 1.8 million ha biodiversity rich forests (DoF, 2015). Nepal possesses a disproportionately rich diversity of flora and fauna at ecosystem, species, and genetic levels with covering only about 0.01 percent of the total global land. Unique geography with rapid change in altitudinal gradient and associated variability in the eco-climatic conditions is the most important local factor contributing to the rich biological diversity in the country. The country's standing at the crossroads of two major biogeographic regions of the world (the Indo-Malayan in the south and the Palearctic in the north) has also contributed to the high biodiversity in Nepal. GoN (2014) has reported that Nepal contains 35 forest types, 75 vegetation types and 118 ecosystems, and provides home to more than 1.1 percent of flora and 3.2 percent of fauna. Nepal is also home to a number of globally rare and endangered plants and animals since CITES has listed 136 species of animals from Nepal including 60 mammals, 61 birds, 12 reptiles, 1 amphibian and 2 butterfly (GoN/MoFSC, 2014).

Despite the abundance of biodiversity in the country, detail account of ecosystem health is not available for all areas including many inaccessible parts. Ecosystems are being reduced at an alarming rate due to forest fire, habitat destruction, growing human population, over harvesting, poaching, and expansion of urbanization and infrastructures. As a result, some unwanted and negative outcome: conversion of forests into other land use is common. Furthermore, the global climate change has been triggering the threats to biodiversity in Nepal. Farr (1998) mentions that biodiversity conservation has become a cornerstone of sustainable forest management in many countries, which needs to be taken into consideration in a country like Nepal. Historically there are two approaches of conservation of biodiversity; one based on protected areas in which humans are kept away, and the other in which the focus is on managing biodiversity with the participation of people. With the increasing attention to socioeconomic aspects and recognition that most of the poor people heavily depend on biodiversity for their survival, the second approach has become widely accepted over the past some decades.

The community forest area in Nepal has rich floral and faunal diversity. Birdlife International (2010) states that out of 27 Important Bird Areas (IBAs) in Nepal, a total of 12 are situated in CF. The biodiversity monitoring practice, however doesn't cover CF, and is still limited within few protected areas (PA) which focus more on protection function and do not satisfactorily cover the issues of cost, utility and participation of local community. There is a need to cover areas containing high conservation value forests located outside of protected area and managed

by the local people as community forests. Seeking union between forest conservation and generation of economic activities based on forest resources is being recognized as a one of the strategies of forest management for areas where people and forests are inseparable, or where establishment of protected areas by removing people is difficult to achieve.

Recognizing the need of people centered natural resource management to generate the dual benefit of biodiversity conservation and local livelihood improvement, ANSAB initiated an approach of enterprise based biodiversity conservation in Nepal since its establishment in 1992. It has been working in community-public-private partnership model, and adopting participatory approach in identifying and facilitating for sustainable forest management, enterprise based biodiversity conservation, sustainable production, processing, and marketing of forest-based products and services keeping the biodiversity in balanced and healthy conditions thorough a participatory biodiversity monitoring approach in various forest management units (FUGs) in different physiographic regions of Nepal since 1996. Based on the experience and literatures, a set of practical tools and techniques are developed, tested and applied in community-managed forests in Nepal that are documented as a training manual on participatory biodiversity monitoring and guideline of identifying rare and threatened wildlife species in Nepal. These participatory tools and techniques are applied in over 563 forest user groups in 19 districts of Nepal that have brought over 112,113 ha of forest and meadows containing biodiversity hotspots under improved management, some of them already received Forest Stewardship Council (FSC) certification meeting the international standards of sustainability (ANSAB, 2014).

This paper intends to communicate among wider readers about the participatory biodiversity monitoring by providing tools needed to generate useful monitoring data to track the impact of forest management activities on biodiversity. This paper mainly highlights the methodological framework, comprehensive criteria and indicators, and methods of measurement that need to be followed to observe the changes in the forest health, social and economic contribution of forest users with important learning obtained from its practices and action researches.

2.0 METHODOLOGICAL APPROACH

ANSAB initiated biodiversity monitoring practices at local level with the communities who were already using biodiversity primarily for subsistence and also for trade. Biodiversity is divided into three broad components ecosystem diversity, species diversity, and genetic diversity but this paper has basically focused on species and ecosystem diversity pertaining to the richness of species and ecosystems within a landscape having forests and meadows on which local communities depend for their livelihoods. Apart from the use of biomass by communities, land use changes, fires, road construction and landslides are common forms of disturbances. Though mainly based on biological aspects, the participatory biodiversity monitoring gives special focus on changes in peoples' capacity, perception and behavior with regard to biodiversity use and management. In addition, enforcement mechanisms are instituted to control inappropriate harvesting and threats to biodiversity.

As shown in the figure 1, *social response* greatly influences *threats to biodiversity*, which affects the *ecosystem health and vitality*. These three criteria guide the whole biodiversity monitoring and develop and apply corrective actions.

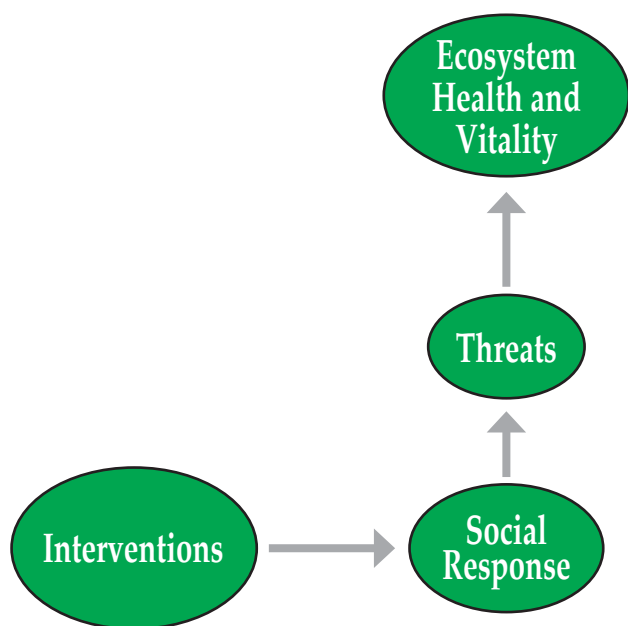


Figure 1: Methodological approach for participatory biodiversity monitoring in community forestry

Participatory biodiversity monitoring, an important aspect to maintain diversity and promote sustainable development in changing climate situation, is based on participatory processes, approaches, tools and techniques. It helps forest managers to get empowered and generate useful data. Besides the above mentioned methodological approach, different tools such as Resource Inventory (RI), Transect Walk (TW), Focus Group Discussion (FGD), household survey, Key Informant Interview (KIS), FUG and enterprise records, photo monitoring and experimental plots (EP) were used to gather information at FUGs level.

Criteria and Indicators

Mainly, three criteria namely i) ecosystem health and vitality, ii) anthropogenic pressure and iii) enhancing factors were used in biodiversity monitoring. Each of the criteria has a set of indicators and verifiers that was developed through discussions with wide range of stakeholders and locals as well as its implementation as an action research in the large area of high mountain districts of Nepal. Depending on the complexity, relevance and costs, these indicators could be measured at different levels of precision and frequency.

Criteria 1: Ecosystem health and vitality

The health and vitality are crucial for an ecosystem to be productive and self-sustaining, and to have a built in capacity to cope with threats as well. The preservation of biodiversity is possible in a healthy ecosystem that can retain its structure and perform functions effectively. In order to monitor ecosystem health, biotic features that are easily measurable were considered. The group of indicators was used to assess the health and vitality of an ecosystem such as vegetation types, crown cover, old growth trees, logging intensity, coarse woody debris (CWD), regeneration and growing stock, growth and yield. The indicators along with their verifiers, units and methods of measurement are presented in Table 1.

TABLE 1: INDICATORS, VERIFIERS AND METHODS FOR ECOSYSTEM HEALTH AND VITALITY

Indicators	Verifiers	Unit Of Measurement
Ecosystem Health (Forest)		
Vegetation types	Types	Nominal
	Area of each type	Ha
	Characteristics	Qualitative
Crown cover	Crown cover of trees	%
	Shrub crown cover	%
	Ground cover	%
Dead trees	Vol. of dead & fallen trees	M ³ /ha
	Area covered by CWD	M ² /ha
	Fine litter	4 point ordinal scale
Old growth trees	Density of old trees	No./ha
Fungal fruiting bodies	Fungal fruiting bodies	M ² /ha
Lopping intensity	Lopped trees	No./ha
	Av. lopping intensity (individual tree)	%
Ecosystem Health (Meadows)		
Height	Mean height of the vegetation	M
Plant species diversity	Species richness	No. of species
	Invader species richness	No. of species
	Density of invader species	No./ha
Green biomass	Quantity of green biomass	kg/ha
Organic matter on the ground	Organic matter at A horizon	%
Growing Stock		
Growing stock by	Pole size	m ³ /ha
Species (Tree)	Mature tree	m ³ /ha
	Over mature tree	m ³ /ha
Size class distribution by species (Tree)	Pole size	No./ha
	Mature tree	No./ha
	Over mature tree	No./ha
Density by species (Shrub)	Mature Plant	No./ha
Distribution and	Utilizable biomass	kg/ha
Biomass of herbs by species	Plant density	No./ha

Indicators	Verifiers	Unit Of Measurement
Growth and Yield of Select Economic Plant Species		
Growth	Tree diameter growth	mm/year
	Shrub height growth	cm/year
	Utilizable biomass growth (herbs)	kg/ha/year
Yield	Product yield	kg/ha/year
Regeneration		
Tree & shrub regeneration by species	Seedlings	No./ha
	Saplings	No./ha
	Coppices	No./ha
	Root suckers	No./ha
Herb regeneration by species	Young growth	4 point ordinal scale
Habitat characteristics of regeneration patches	Soil type	Nominal
	Humus quality	4 point ordinal scale
	Erosion features	Qualitative
	Moisture stress	Qualitative
	Digging by wild animals	Qualitative
	Nursing role of shrubs, bamboo and others	Qualitative
	Canopy gaps	Qualitative
	Disturbance to survival and growth (grazing, fire, insects and diseases)	Qualitative
	Species	Number
	Habitat distribution	Area in hectare
Wildlife and Birds	Dead animals bodies	Species/number
	Digging by wild animals	Area/ha
	CITES listed species	Number
Birds	Species	Types
	Habitat distribution	Area in ha
	Population	Number

Criteria 2: Threats to biodiversity

Many species of flora and fauna are seriously threatened primarily due to human induced pressures such as removal of branches before flowering and seeding, removal of vegetations, uncontrolled fire, hunting and illegal logging, grazing and encroachment etc. The Scale, Intensity and Risk (SIR) of threats may be different depending on forest management groups and location. Thus, the forest managers listed the major threats and prioritized them based on their SIR. For instance, the common threats of CF have been outlined in Table 2 along with verifiers, unit and methods of measurements.

TABLE 2: INDICATORS, VERIFIERS AND METHODS FOR THREATS TO BIODIVERSITY

Indicators	Verifiers	Unit of Measurement
Fire damage	Area	m ² /ha/year
	Frequency	No./year
	Type	Crown, ground, surface
Biomass removal	Timber	m ³ /ha/year
	Fuel-wood	kg/ha/year
	Fodder	kg/ha/year
	Grasses	kg/ha/year
	Bedding materials (leaf litter & syaula)	kg/ha/year
	Poles & implements	m ³ /ha/year
	Other NTFPs by products & species	kg/ha/year
Grazing	Area	Ha
	Livestock units	No./ha/year
	Period	Months/year
Encroachment	Area by types	m ² /year
Harvesting practices by products	Season	Degree of appropriateness
	Tools used	Degree of appropriateness
	Method/techniques	Degree of appropriateness
Illegal harvesting	Species	Types
	Area	No/Ha.
	Frequency	No./year
	Person involved	No./year
	Season	Degree appropriateness

Criteria 3: Enhancing factors

Enhancing factors encompass monitoring of organizational and individual behaviors of FUGs, local harvesters, enterprise beneficiaries, herders, and other beneficiaries to the biodiversity. Key systems, practices and actions related to biodiversity include harvesting, fire, silvicultural operations, promotion of regeneration, and protection/damage to wildlife. Such behaviors (that are related to resource conservation and utilization) are a function of perceived ownership over the resource; existing knowledge systems; cultural factors; perceived value of resources to livelihoods; and institutional arrangements for resource management, conflicts, skills and technologies. Changes in knowledge, attitudes, skills and conservation behaviors were monitored periodically in CF. As we practiced in CF, the details of indicators, verifiers and unit of measurement are provided in Table 3.

TABLE 3: INDICATORS, VERIFIERS, UNIT OF MEASUREMENT AND METHOD OF MEASUREMENT

Indicators	Verifiers	Unit of measurement
Perception towards value of forest	Types of value	Number
	Direct use value	Descriptive
	Indirect use value	Descriptive
	Existence value	Descriptive
	Value	Descriptive
Forest management operations and protection	Silviculture operation (Thinning, pruning, singling-season)	Descriptive
	Plantation of timber species	Hectare
	Plantation of non-timber species	Hectare
	Protection methods	Types
	No. of Encounter and charge to the hunters and illegal fellers	No/type
	Provision of management activities in operational plan	Yes/no
	Grazing system (rotation system implemented?)	Yes/no
	Is management plan implemented effectively	Yes/no
Forest product demand and distribution pattern	Timber demand	Cu.ft
	Firewood demand	Bhari
	Fodder and grasses demand	Bhari
	Agriculture Implements	Cu.ft
	Is distribution system equitable	Y/N

Institution and governance	Established year	Date
	Member in FUC	No
	Female member	No
	Dalit member	No
	Committee meeting	No
	Participation of committee meeting	No
	General assembly	No
Income Generation and fund mobilization	Bank account	No
	Total cash income	Rs
	Income this year	Rs
	Income from forest product	Rs
	Income from penalty	Rs
	Expense this year	Rs
	Expense in conservation activities	Rs
	Loan provided to FUG members	No
	Loan amount	Rs
	Account system	Y/N
Threats reduction strategies	Mitigation plan	Yes/no
	Implementation of threats mitigation plan	Yes/no
	Changes in threats status	%
	Poor people's perception to threats and its mitigation plan	Four ordinal scale
	Medium people's perception to threats and its mitigation plan	Four ordinal scale
	Rich people's perception to threats and its mitigation plan	Four ordinal scale
	Commitment of poor people to threats reduction	Four ordinal scale
	Commitment of rich and medium people to threats reduction	Four ordinal scale
Perception on key features of the biodiversity	Provision of habitat management	Yes/no
	Provision of red listed species of flora and fauna	Yes/no
	Biodiversity registration book	Yes/No
	Delineation of important social and religious area	Yes/no
	Economically important species	Yes/no
	Other unique features	Yes/no

3.0 METHODS OF MEASUREMENT

Various tools such as RI, TW, KIS, FGD, FUG and enterprise records, experimental plots and photo monitoring were used to monitor ecosystem health and vitality, threats to biodiversity and enhancing factors. All or some of the tools for a FUG are applicable keeping in view the feasibility and capacity of communities and their objectives of management. The methods have been briefly presented in Table 4.

TABLE 4: METHODS OF MEASURING INDICATORS

Methods	Indicators and Verifiers Measured	Frequency of Measurement
Resource Inventory	Vegetation types and characteristics, plant species diversity, crown cover, dead and fallen trees, organic matter on the ground, growing stock (size class distribution, plant density of herbs, green biomass, vegetation height), growth, regeneration, threats (fire, grazing, encroachment, biomass removal)	Once in five years (during forest management plan (FMP) preparation and revision)
Transect Walk	Vegetation types and characteristics, plant species diversity, fungal fruiting bodies, lopped trees, crown cover, ground cover, dead and fallen trees, old growth trees, area covered by CWD, organic matter and fine litter, factors of regeneration, threats (fire, grazing, encroachment)	Biennially (including at the time FMP preparation and revision)
Household Survey	Demography, cattle population, household-wide forest product demand, agricultural land, education	Once in five years (at the time FMP preparation and revision)
Focus Group Discussion	All indicators related to threats and social response	Yearly
Key Informant Survey	Indicators related to threats, enterprise effects, social response	Yearly
FUG and Enterprise Records	Community participation in conservation, forest management, harvesting and use, threats (fire, theft, encroachment, etc.), fund mobilization, enterprise contributions which can be used by communities, entrepreneurs, forest authorities, federation of forest users.	Yearly
Experimental Plots	Utilizable biomass, growth and yield (important species from conservation and trade point of view)	Yearly
Photo monitoring	Ecosystem, Habitat of birds and wildlife	Periodic (five years)

4.0 LESSON LEARNED

The CFUGs that are oriented to enterprises and commercial activities have incorporated biodiversity monitoring related provision in their forest management plan and also implemented the plan. For that, these CFUGs need to be capacitated for certain period of time providing hands on training and regular follow up.

The CFUGs might be highly interested on biodiversity monitoring while they understand the importance of sustainable forest management, and move from conservation oriented management to commercial management promoting equitable benefit sharing mechanism.

Currently, this practice is restricted in very small number of groups and area with effort of certain projects. The government has no or very limited interest and effort to bring participatory biodiversity monitoring into practice within community managed forests. If the government promotes sustainable forest management practices in all forest management regimes and units, the participatory biodiversity monitoring could be instrumental to conserve biodiversity outside of protected areas as one of the regular activities of the groups.

The CFUG and DFO have certain level of annual monitoring and reporting system. But the existing monitoring and reporting system does not adequately address to the biodiversity monitoring. Thus, implementation of participatory biodiversity monitoring in the district can be an exemplary to CFUGs, DFO and other stakeholders to learn participatory biodiversity monitoring.

5.0 CONCLUSION

Biodiversity is directly linked to the livelihoods and economic wellbeing of rural Nepalese people who directly depend on natural resources for deriving their livelihoods. Nepal's rich biodiversity is also an important source for generating revenue to the government. Nepal is rich in biodiversity hot spots and diverse range of products that are unique and valuable but facing some negative/unwanted outcomes due to acute poverty, conversion of forest into the agriculture land, unmanaged/illegal harvesting, and poaching of wildlife which is further impacted by the global climate change. Monitoring of biodiversity could provide important informational input to the local communities who seek to generate income and employment through the proper use and sustainable management of biodiversity.

Biodiversity indicators in their monitoring plans and methodology help to stimulate discussion about useful indicators of forest condition, and thoughts and debate about what had changed, why and how. In addition, it provided a useful framework for highlighting differences between individuals in terms of what they value. Thus the participatory biodiversity monitoring is an important

foundation for exploring who makes decisions based on whose values. By making such differences explicit and transparent, this approach can help to enhance realization of environmental quality and the equity of decision-making and benefit-sharing, which can in turn contribute to stronger biodiversity values through adapting and replicating it into a wider range at landscape level.

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Darter by Jyotendra Jyu Thakuri

Policy and Legal Frameworks for Mainstreaming of Biodiversity in Community Forestry

Dil Raj Khanal

Abstract

Nepal has been maintaining her good status at regional and global level for the conservation of biodiversity through community-based forest management regimes including community forestry. The main legislative instruments of forestry sector of Nepal (Forest Act 1993, Forest Regulation 1995 and associated directives and guidelines) have given emphasis for the conservation of biodiversity through community forestry. Similarly, the regulations of Buffer Zone and Conservation Areas of Nepal have also accepted that the community forestry is an established system for conservation of biodiversity within and outside of protected areas.

The policy instruments specifically National Biodiversity Strategy and Action Plan (NBSAP) 2014, Forestry Policy 2015, Wetland Policy 2013 and many other relevant policies have also widely recognized the role of community forestry for the conservation of biodiversity. Therefore, policy strategies of these policies are main opportunities to Community Forestry Users Groups (CFUGs) for widening their role in order to conserve biodiversity in community forestry.

Despite lots of legal and policy opportunities and success stories to conserve biodiversity in community forestry, still there are some important provisions missing in the forest management plans of community forestry, which is main challenge to CFUGs for mainstreaming of biodiversity aspects in the community forestry. Government of Nepal has banned some species for collection and commercialization from all types of forest. Therefore, CFUGs are not interested to conserve those species, though which species are highly important for the conservation of biodiversity. Some experiences have been shown that the only strict legal arrangements may not enough for the conservation of biodiversity and it is required to make legal arrangement to provide incentive and rewards to local communities who have contributed for the conservation of biodiversity at local level.

An effective, efficient and equitable benefit sharing arrangement and management of human-wildlife conflicts are also highly important legal issue for the conservation of biodiversity in community forest. Government of Nepal has developed some legal arrangement to address these issues, though these legal efforts are not enough and there are some scopes for legal reform to address these issues. Community Forest has also contributed to fulfil the state's obligation generated from multilateral environmental agreements (MEAs), however there is weak linkage between community forestry and the objectives of MEAs.

In this paper, the author will highlight the strength, weaknesses, opportunities and threats / risks for mainstreaming of biodiversity conservation in Community Forest in Nepal from legal points of view.

Key words: Policies, Community Forest, Biodiversity, Conservation, Legal Measures, Incentives

1.0 INTRODUCTION

The biodiversity conservation law is a part of public international law, which deals with the roles, responsibilities and functions of the state and non-state actors to conserve and sustainable use of biodiversity as per national laws considering the customary practices of Indigenous Peoples and local communities. One of the main source of law on biodiversity is a customary practices of local communities which have been applying since ancient period for the conservation of biodiversity (UNEP, 2005).

Many countries have contributed for the evolution of biodiversity laws through bi-lateral agreements for the conservation of trans-boundary and boundary rivers, wetlands and migratory wild lives including birds since last many decades. USA and Canada, members states of EU and South-East Asia have played significant role in this process, though there is lacking a comprehensive regional agreement in South Asia for this purpose and only some Multi-lateral Environmental Agreements have been complying by the state party of this region in order to conserve biodiversity.

Atmosphere and climate, Antarctica, deep sea resources, migratory species, endangered species and biodiversity are global common and there is shared jurisdiction and responsibility among states for the conservation and sustainable use of these resources. It is a universal understanding. The following two global concepts for the conservation and utilization of common, have been playing a dynamic role for the evolution of biodiversity law at global, national and local level:

Common heritage of humankind: It is a principle of international law that defined territorial areas and elements of humanity's common heritage should be held in trust for future generations and be protected from exploitation by individual nation states or corporations.

Common concern of humankind: According to this concept, humankind has common interests in protecting and managing the global environment, climate system and biological diversity for both present and future generations.

Biodiversity is a common concern of humankind and subject of national sovereignty, however there is shared responsibility within permanent sovereignty over natural resources including biodiversity.

As a party of around 30 Multilateral Environmental Agreements (MEAs), Nepal has formulated lots of domestic legal instruments and policy, strategies, plan and program to implement these MEAs (IUCN Nepal, 2013).

State policies of Interim Constitution of Nepal 2007 and recent Constitution of Nepal, 2015 has also given high priority for the conservation and sustainable use of biodiversity through community-based natural resource management regimes. Likewise, sector specific policy and legal instruments have given emphasis on biodiversity

conservation and provided opportunities to Forest User Groups for the conservation and sustainable use of biodiversity.

In this paper, the author has specifically given emphasis on legal arrangements for the conservation and utilization of biodiversity in Nepal and associated legal issues which require to address for the promotion of role, responsibility and rights of FUGs to strengthen their contribution in this sector.

2.0 OBJECTIVES

Main objectives of this paper are to:

- Explore Nepal's national and international legal commitments for the conservation and sustainable utilization of biodiversity through community forestry,
- Analyse the extent of opportunities and gaps in the national legal frameworks for conservation and utilization of biodiversity in community forestry,
- Offer practical and specific recommendations to the policy makers and CFUGs in order to reform in legal frameworks at national level and operational instruments at community level.

3.0 MATERIALS AND METHODS

An analytical method was applied to review of the content of relevant international and national legal and policy instruments including national strategies, plans and program concerning with biodiversity. Few selected operational plans of CFUGs were also reviewed to identify the community commitments for the conservation of biodiversity through community forestry. Relevant publications of various agencies and organizations and news published in national newspapers were also reviewed during the drafting of this paper. Some comments of the participants of the national workshop on this topic were also addressed in the paper.

International conventions ratified by the Government of Nepal and their communications reports; legislative instruments related to forest, protected areas, environment and developments; directives and guidelines of community forestry; forestry and protected areas related policy, strategy, plans and program and operational plans of CFUGs are used as an important material for this article.

4.0 FINDINGS/RESULTS

Nepal has ratified more than 30 multilateral environmental agreements which have shown the strong commitment of the Government of Nepal to conserve biodiversity. Government can comply these commitments through community forestry and it has also created opportunities

for FUGs to involve in the conservation and utilization of biodiversity.

The constitutional and legal commitments of the state to conserve biodiversity is also highly valuable. In the context of Nepal, our legal measures have created lots of space to FUGs to conserve and use the biodiversity through community-based forest management including community forestry.

CFUGs have generated a good result in the areas of biodiversity conservation and utilization of it for livelihood through utilizing these legal measures. The biodiversity conservation is an integral part of community forestry based on the existing legal provisions.

Nepal has formulated lots of guidelines, strategies, plans and programs to promote community participation in activities related to biodiversity conservation, though there are some legal issues which require to address through legal reform in a consultative and participatory way. The major findings of this study are as following:

4.1 Nepal's international commitment for the conservation of biodiversity

Nepal has ratified Ramsar Convention 1971, World Heritage Convention 1972, CITES 1973, CBD 1992 and UNCCD 1994 which are highly important to promote community participation in biodiversity conservation and sharing of benefits. The major provisions to promote community participation of these instruments are as following:

Among these conventions, the CBD is highly helpful for local community to promote their role and rights over biodiversity and associated benefits. Ratification of CBD is a global commitment of the state party in order to conserve and utilization of biodiversity through Indigenous People and local communities. CBD has defined the obligation of state party to adopt general measures for conservation and sustainable use of biodiversity by developing national strategies, plans or programmes and integration of biodiversity conservation measures into relevant sectoral or cross-sectoral plans, programmes and policies.

According to Article 8 (j) of the CBD, each Contracting Party shall respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

Every country requires to enact a law related to access and benefits sharing in order to effective implementation of this article and ensuring an equitable benefit sharing to local communities who are conserving biodiversity, though Nepal has not enacted such legislation so far. A bill on this subject was drafted around 10 years ago, though due to lack of consensus between stakeholders this bill is still not moving forward. Therefore, local communities are advocating to finalize the bill drafting process and its adoption.

Conventions	Objectives and provisions for community participation
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention), 1971	Conservation of wetlands and their flora and fauna by combining far-sighted national policies with co-ordinated international action.
Convention on for the Protection of the World Cultural and Natural Heritage, 1972	To establish an effective system of collective protection of the cultural and natural heritage of outstanding universal value.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973	To establish international co-operation for the protection of certain species of wild fauna and flora against over-exploitation through international trade.
United Nations Convention on Biological Diversity (CBD), 1992	Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources
UN Convention to Combat Desertification in those Countries Experiencing serious Drought and or Desertification(UNCCD), 1994	To combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification.

4.2 Constitutional commitments for the conservation of biodiversity

The Constitution of Nepal 2015 has recognized the right to clean and healthy environment, rights to drinking water, right to food, rights of farmer, rights to shelter for socially marginalized people and rights to land for women and socially marginalized people as a fundamental rights. These rights may be promoted through biodiversity conservation. However, all these rights are ensured as an individual rights and not as a collective rights or common property rights, which is important for the conservation of biodiversity. The article 51(g) (5) has given special emphasis for the conservation and sustainable use of biodiversity, which a strong state policy for this sector.

The constitution has incorporated rights to benefit for local communities generated from natural resources, but constitution has not given rights to local communities over the natural resources which now they are managing as a common property such as community forestry. Only the rights to benefits sharing may not be sufficient for the conservation of biodiversity without guarantying rights to natural resources of local communities. This is the critical aspect of new constitution of Nepal in the context of resource conservation.

4.3. Legal instrument for the conservation of biodiversity through local communities

Legislations related to forest management, protected areas management and environmental protection has incorporated some explicit provisions to promote community ownership and participation in the biodiversity conservation. Forest Act 1993, Forest Regulation 1995 and associated various directives and guidelines; National Park and Wildlife Conservation Act 1973 and associated regulations and other sectoral legislation such as Environmental Protection Act 1997 and Regulation 1997, Local-self Governance Act 1999, Mine and mineral Act 1985, Water Resource Act 1992, Electricity Act 1992, Industrial Enterprise Act 1992 etc. have also made some implicit provisions for the community involvement in order to biodiversity conservation.

Forestry legislation

One of the important objective of the *Forest Act 1993* is to conserve forest, environment and biodiversity through community forestry. Therefore this act has given high priority to community forestry program for the conservation of biodiversity. The *Forest Regulation 1995* has clearly stated that conservation of forest and protection of wildlife including biodiversity should be an integral part of community forest. The CFUGs require to make special arrangement in their Operational Plans for the conservation and use of biodiversity including herbs and NTFPs.

Community Forestry Directive 1996 has made some provision for safeguarding biodiversity conservation during the implementation of plans related to cash crops and

enterprise through CFUGs. According to this directive, it is require to give priority for the conservation of biodiversity during the operation of such income generating activities within community forest.

Directive on Sales and Distribution of Forest Product of CF 2014 has also highlighted the conservation measures. It has stated that the timber harvesting practices in CF should be environmental and biodiversity friendly. *Resin Collection (Procedure) Directives 2007* has given emphasis on obligation of collectors to protect biodiversity. According to this directive, the collectors should ensure protection of biodiversity during the collection of Resin from Community Forestry. The guidelines of *Community Forestry Development Program Guideline (revised 2015)* has also given some guidance for the conservation and utilization of biodiversity including wildlife and environmental services, it should be mentioned in the management plan of CF.

Resource inventory guidelines of forestry sector has also set up some steps and process for the inventory of biodiversity during the preparation of various level management plans. *CF Resource Inventory Guideline (2061 BS)* has not explained the steps and process for the inventory of NTFPs, though it has given emphasis for the inventory of herbs and NTFPs during the formulation of Operation Plans of CF for the conservation and utilization of these resources. *NTFP Inventory Guideline (2069 BS)* is another complimentary guideline which has designed the basic steps and process for the inventory of 30 prioritized herbs, medicinal/ Aromatic plants and NTFPs and recommended activities for conservation and sustainable use through CF.

Conservation Legislations

Nepal has enacted various legislations for the protection, conservation, management and utilization of biodiversity since last many years. Out of these legislations the following legal instruments have given emphasis for the conservation of biodiversity through community forestry:

Buffer Zone Management Regulation 1996 has mentioned that the work plan of BZCFUGs should be a biodiversity friendly and require to incorporate measures for the conservation and utilization of biodiversity in the management plans of community forestry. *Conservation Area Government Management Regulation 2000* has also made provisions in this regard and mentioned that Conservation CFUGs can conserve and utilize the biodiversity considering the integrated management plan of conservation area. *Kanchanajhangha Conservation area Management Regulation 2007* has also mentioned that Conservation CFUGs can conserve, utilize and marketing of herbs, medicinal plants and NTFPs from CF based on the approved management plans.

Environmental Protection Act 1997 and Regulation 1997 have legally defined the biodiversity and covered ecosystem, species and genetic diversity under biodiversity. EIA and IEE approval is legally binding for those development activities which impact in the biodiversity and forest. IEE and EIA approval is require for those plans of CF

which cover more than defined area/thresholds (IEE for plan of 500-750 ha. and EIA for plan of more than 750 ha.). Though, CFUGs are not satisfied with this provision and continuously advocating to made change in this provisions and they are arguing that one of the objective of the community forest is to conserve biodiversity and environment, therefore it is not require to conduct EIA and IEE of the management plan of the community forestry.

Directive for Distribution of Relief to lose and damage from Wildlife (amended 2015) has made special provisions for the distribution of reliefs to the victims of human-wildlife conflicts. According to this directive, CFUGs can distribute relief to victims from wildlife in their community forestry. It has creating an enabling environment for the conservation of biodiversity through community forestry in Nepal.

4.4 Policy measures for the conservation of biodiversity through local communities

Nepal Biodiversity Strategy and Action Plan (2014-2020) and Forest Policy 2015 are the main sectoral policies, which has given high priority for the conservation of biodiversity through local communities including Community Forestry Users Groups. These policies have also implicitly recognised the concept of Indigenous and Communities Conserve Areas (ICCA). The major provisions of these policies for the conservation and sustainable use of biodiversity through local communities including CFUGs are as follows:

Forest Policy 2015

According to this policy, CFUGs may maintain connectivity of CF areas for the conservation of biodiversity according to their interest. This policy has also given rights to CFUGs for the management of indigenous and community conserve areas (ICCA) through CF, establishment of rescue centre for injured wildlife and promotion of eco-tourism through conservation of biodiversity. The policy has also recommended to maintain coordination with other sectoral (herbs and NTFPs, NBSAP, land-use, agriculture, tourism etc.) during its implementation.

Nepal Biodiversity Strategy and Action Plan (2014-2020)

Some of the major principles of the NBSAP are to promote full and effective participation of local communities in the biodiversity related program; recognize knowledge, innovations and practices of indigenous and local communities which play crucial roles in the management of biodiversity and legitimate rights of indigenous and local communities, women, dalits, and other disadvantaged social groups over local biological resources deserve due recognition. One Strategic Approach of this strategy is promoting participation, cooperation and collaboration of stakeholders. Out of the various strategies, one strategy is to improve in conservation of biodiversity in community-managed forests. Other important strategies are promoting equitable participation of all sections of the society in the development and implementation of conservation policies

and programmes as well as ensuring equitable access of women and men, including disadvantaged social groups to biological resources and benefits sharing.

Integrating traditional knowledge, innovations and practices of indigenous and local communities in the management of biodiversity and ecosystems is also another important strategy of NBSAP.

The above mentioned policies and strategies have created some space to local communities including CFUGs for the conservation and utilization of biodiversity. However, an effective implementation of these policies through local communities is urgent to achieve their vision, mission, goal and objective in a certain time period.

4.5 Emerging policy/legal issues

Management plans of majority CFUGs have highlighted the existing status of biodiversity and their protection measures, though there is inadequate reflection of legal/policy provisions in management plans of many CFUGs for mainstreaming of biodiversity conservation and its sustainable use.

GoN has issues some notices to band for harvesting/ collection and marketing of some species and it has been disempowering to CFUGs for the conservation of those species. Many CFUGs has no legal awareness on biodiversity laws and they are facing lots of legal complexities during the utilization of biodiversity resources.

Due to conflicting or overlapping jurisdiction between Forest Act 1993 and Local Self-Governance Act 1999 to use the resource of wetlands and for the conservation of biodiversity, it has created lots of conflicts between local communities and local government.

A complex procedure to establish enterprise for the utilization of biodiversity resources in order to enhance livelihoods is also an important policy issue in this sector.

CFUGs have no authority for hunting or provide licence for hunting of those wildlife which are more than carrying capacity of CF and are not endangered. It has created lots of challenge to CFUGs for the management of wildlife in the community forest. Increasing human-wildlife conflicts and weak policy/legal arrangement to address this issue is also another challenge to CFUGs. Similarly the lengthy process to provide relief to the victim of these conflicts has also facing by the CFUGs who are managing biodiversity.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Despite lots of legal and policy opportunities and success stories to conserve biodiversity in community forestry, still there are some important provisions missing in the forest management plans of community forestry, which is main challenge to CFUGs for mainstreaming of biodiversity

aspects in the community forestry. The major conclusion and recommendation of this study are as follows:

- Existing policy and legal frameworks have given enough space for the conservation and utilization of biodiversity through Community Forest. Management plans of CFUGs have also addressed for the conservation of biodiversity, though there is weak link between traditional knowledge on biodiversity and its conservation.
- It is require to remove procedural complexities in order to promote the conservation and utilization of biodiversity through biodiversity friendly enterprise which are operating by CFUGs at local level.
- Legal reform of Buffer Zone and Conservation Area is urgent to maintain access to benefit for CFUGs of these areas which have highly contributed for the conservation of biodiversity and environmental services.
- A decentralized and an effective mechanism to address human-wildlife conflicts and distribution of relief is urgent for the conservation of biodiversity through community forestry.
- Right to hunting is also necessary to provide to CFUGs for addressing the problems created by those wildlife which are not endangered.

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Using the Non-market Value of Ecosystem Services to Mainstream Biodiversity into Community Forest Management

Rajesh K Rai¹, Priya Shyamsundar², Mani Nepal³ and Laxmi Dutt Bhatta⁴

Abstract

This study estimates the economic value of ecosystem services generated from the management of community forests at sub-watershed level. A total 300 households were surveyed in Jhikhu khola watershed of Kavrepalanchok district. We used discrete choice experiment method to estimate the value of ecosystem services generated from ecosystem management at watershed level. Random parameter logit model was used to analyze choice responses. Three data sets were generated to analyze the data including pool, upstream and downstream.

The results indicate that drinking water, irrigation water, forest litter and fuelwood are the locally important ecosystem services. Forest users are keen to contribute to management activities through their community forest user groups. On average, forest users are willing to pay NPR 29 per year for one additional liter of drinking water per household per day during the dry season. They are willing to pay more than NPR 1,444 per year for an additional month of irrigation. Respondents are willing to pay approximately NPR 1,300 for an additional 30 baskets of leaf litter per month or NPR 43 per basket. This reflects the value of leaf litter as a substitute for chemical fertilizers. Respondents are willing to pay approximately NPR. 117 per *bhari* or head load fuelwood. The estimated average annual household willingness-to-pay is NPR. 3,136 for the specific community forest management scenario.

In addition, up-stream community member are willing-to-pay 1.37 times more for watershed services relative to downstream members. In addition, drinking water demand, irrigated land holding size and sex of respondents are main demographic characteristics to determine willingness-to-pay of forest users. The study suggests that choice experiment is useful tools to mainstream biodiversity into community forest management.

Key words: Choice Experiment, Economic Valuation, Willingness-to-Pay, Upstream, Downstream, Forest Products

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1.0 INTRODUCTION

Forests in developing countries have received considerable attention in international climate policy discussions. Forest depletion in these countries is responsible for approximately one-fifth of all anthropogenic carbon emissions (IPCC, 2007). The causes and drivers of deforestation are multifaceted, and range from subsistence use to commercial exploitation (Geist and Lambin, 2001; Fine, 2002). For this reason, no single strategy can be effective to protect these forests and curb the current destructive trend. Reversing this trend requires addressing a myriad of social issues, including poverty and governance decisions (Agarwal, 2001; Scherr *et al.*, 2003; CFD, 2004).

Forest governance is receiving increasing attention in international forest policy discussions, which are primarily aimed at addressing the problems associated with the depletion of forest resources. The participation of local community and market actors in addressing future governance challenges is necessary to lead to effective governance (Agrawal *et al.*, 2008). Economic valuation is considered a tool for promoting good ecosystem governance through the supply of information about the values, incentives and options of forest management (King, 2007).

Our study estimates demand for watershed services using non-market valuation technique in the Koshi river basin of Nepal (Merz *et al.*, 2003b). Watershed services are important for rural households to maintain their agriculture and forest based livelihoods (Merz *et al.*, 2003a; Bhandari and Grant, 2007). Furthermore, there is a growing interest in managing watershed services to enable better adaptation to climate change, which is expected to affect both water quality and quantity in many parts of Nepal (Dongol *et al.*, 2005).

2.0 STUDY AREA

This study was carried out in the Jhikhu Khola watershed area in the middle hills of central Nepal. This watershed covers a population of 10,875 households and an area of 11,141 ha. dominated by agriculture and forests. The population is governed by eleven village development committees and the Dhulikhel Municipality of Kavrepalanchok District, while forest patches are managed by some 29 community forest user groups (IUCN, 2007; Central Bureau of Statistics, 2012). Upstream forests are dominated by Chirpine (*Pinus roxburghii*) plantations, while Sal (*Shorea robusta*) dominates downstream areas.

In this watershed, both irrigation and drinking water are seasonally scarce during the dry season (see Table 3). According to local people the landscape and ecosystem services in the region have changed significantly over the last decade, primarily as a result of growth in agricultural markets, population changes and invasion of exotic plant species. Urban demand for vegetables, due to its proximity to the capital city Kathmandu, has triggered

intensive farming with multiple crops and heavy use of chemical fertilizers and pesticides. These practices require increased water usage and can contribute to water quality degradation (Foley *et al.*, 2005).

Furthermore, during the 1970s, most degraded forest patches in the Himalayan region were re-vegetated with pines (Gautam *et al.*, 2003). These pine stands, which are now mature and dense, produce fewer forest products and services such as fuelwood, fodder and leaf litter that are locally useful (Saxena *et al.*, 2002). Pine needles are usually nutrient poor and have a slow decomposition rate (van Wesemael, 1993); if not removed in a timely manner they begin to acidify forest soil (Lavelle *et al.*, 1995), which ultimately limits the regeneration of native vegetation. Furthermore, exotic species are widespread in the pine stands also limit the regeneration of native species, reducing the availability of forest products such as fuelwood and fodder (McWilliam, 2000; Rai *et al.*, 2012).

A common understanding among development practitioners is that integrated watershed management can offer some remedies. This approach seeks to balance ecological, economic and social dimensions of watershed management and can contribute to increases in the availability of ecosystem services (Heathcote *et al.*, 1998). The question is whether the demand for these local services is sufficient to allow villagers to manage watersheds for improved provision of these services and sustain any investments that may be required.

3.0 METHODS

To understand the nature of the local demand for watershed services, we undertook a discrete choice experiment (DCE). The DCE sought to answer two questions: whether demand for improved watershed services differed for different categories of users, particularly for downstream versus upstream users? A random parameter logit (RPL) model was estimated to analyze choice responses. The RPL model is expressed as:

$$V_{ij} = ASC + Yx_{ij} + \eta x_i + \gamma s_i, \dots \dots \dots 1$$

Where, V_{ij} refers to indirect utility obtained by the i^{th} individual for the j^{th} alternative. Y is the sum of the population mean and η is individual deviation of the random parameter, and x is attribute. The alternative specific constant (ASC) captures the effect of unobservable factors on the selection of alternatives relative to the status quo. In this model, socio-economic variables (s) are introduced to detect sources of heterogeneity. Further, interaction terms in s identify the impacts of individual-specific characteristics on selected alternatives and the ASC.

3.1 Selection of attributes

We undertook five 'Focus Group Discussions (FGDs)' in the study area to identify attributes. Participants were

first asked to prepare a list of watershed services and rank them according to their importance. The FGDs indicated that the most important watershed attributes that villagers were interested in were irrigation water, drinking water, fuelwood and leaf litter (Table 1).

FGD participants were also asked to identify changes in attributes that could make a tangible difference to their household. For example, households currently obtain 8 months of irrigation water and participants indicated that they would prefer 10 or 12 months of water. This increased level of irrigation water would allow households to cultivate their farms during the dry season. We also consulted key informants and experts to ascertain the maximum level of enhancement possible for each attribute.

A third issue that was discussed was the payment vehicle (how to collect and manage fees) and mode of payment. Respondents indicate that they would like to pay through their respective community forest user groups (CFUGs). The range of payment is based on the focus group discussion. A ten-year program for managing the watershed was discussed in the FGDs as well as with local officials. These discussions identified a program for integrated watershed management whereby community forest user groups would collect a fee to implement the plan and a sub-watershed level community development

group would be organized to manage activities at the landscape level. The program laid out three conservation activities: gradual conversion of pine forest to broadleaved species, harvesting of sub-surface water from water bodies, and construction of water retention holes and conservation ponds to enhance water availability.

3.2 Experimental Design and survey implementation

We used the Ngene (1.0.1) software for generating experimental designs. Each choice set included two policy alternatives (Alternative 1 and Alternative 2) plus the status-quo. Respondents were asked to pick one alternative out of the three for each choice set. The 20 identified choice sets were divided into five versions of the survey questionnaire. During the survey, each respondent was presented four cards (see Figure 1) and asked to choose one option from each card. Thus, each respondent made four choices.

TABLE 1: ATTRIBUTES AND THEIR LEVELS

Attributes	Description	Levels
Drinking water	Amount of water availability per household (hh) per day during the dry season (February to May) for household use.	i. as much as now (100 liter / day / hh)*, ii. twice as much as now (200 liter / day / hh), iii. thrice as much as now (300 liter / day / hh)
Irrigation water	The number of months during which the irrigation water is available for farming.	i. as much as now (8 months)*, ii. 10 months, iii. 12 months,
Forest Litter collection	Number of leaf litter sacks per household per day during the leaf litter collection period (forest user groups open forests for collection for a month annually).	i. as much as now (1 sack per day)* , ii. twice as much as now (2 sacks per day), iii. thrice as much as now (3 sacks per day),
Fuelwood collection	Amount of fuelwood available per household per year from community forest (forest user groups collect fuelwood and distribute to users once in a year).	i. as much as now (20 bhari) * , ii. 30 bhari, iii. 40 bhari
Watershed management fee	An introduction of new annual fee for watershed management. This is a fee additional to what households are paying now for community forest membership. Users can pay in twelve monthly installments.	i. No additional fee*, ii. NPR. 600, iii. NPR. 1,800, iv. NPR. 3,000.

* Levels used in status quo (current situation).





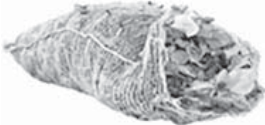










Attributes	Alternative 1	Alternative 2	Current situation																																																
Drinking water 	200 liters / day 	200 liters / day 	100 liters / day 																																																
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Figure 1: An example of choice set

Face-to-face interviews were carried out with 300 households, 150 each from upstream and downstream areas. A systematic sampling approach was used to select households. Villages within the watersheds were first geographically stratified into upstream and downstream locations. Then from each geographical group, 10 *wards* of different village development committees were randomly selected and 15 households from each *ward*. The first household was selected randomly and then every 6th household was interviewed on both sides of a street. The available head of household (male or female) was interviewed.

4.0 RESULTS AND DISCUSSION

4.1 Sample characteristics

Table 2 presents basic socio-economic information and compares upstream and downstream households. Only about a sixth of the farmers (17%) generate sufficient income to sustain their livelihoods from farm production, while one tenth maintain their family expenditure for less than three months from their farm income. A majority (87 percent) of the families have a traditional house and one third (36%) of households use traditional stoves. Likewise, 13 percent households have pit toilets, while six percent practice open defecation.

TABLE 2: SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS (STANDARD ERROR IN PARENTHESES)

Characteristics	Location (n=300)	
	Upstream	Downstream
Age (years)	45.28 (15.59)	46.67 (15.61)
Education (years)	2.75 (2.14)	3.03 (2.48)
Family size	4.71 (2.13)	4.26 (1.87)
Irrigated land (ha)	0.17 (0.16)	0.27 (0.25)
Unirrigated land (ha)	0.29 (0.27)	0.24 (0.30)
Drinking water demand (Liter/day/family)	276 (175)	291 (196)
Traditional house	141 (94%)	121 (85%)

4.2 Choice responses analysis

All RPL models are statistically significant with Chi-square statistics of 307.24 and 594.25 for upstream and downstream respectively. As per expectations, respondents in both communities prefer the condition with increased availability of drinking water, irrigation water, leaf litter and fuelwood in the watershed but lower watershed management fee. Both upstream and downstream respondents having high water demand select the alternative more frequently compared to respondents having less water demand for household use. While family size has contrasting effects on selecting watershed management alternatives between upstream and downstream households. For instance, downstream respondents having large family size are less likely to select the alternatives over status quo. On the contrary, upstream respondents having large family size are likely to select alternatives more frequently. While exploring the reason for this divergent result, the correlation coefficients indicate that, in upstream, larger family size means small irrigated land holdings and living far from community forest.

TABLE 3: RESULTS OF RPL MODELS (UPSTREAM AND DOWNSTREAM SUB-SAMPLES OF MONETARY COHORT)

Variables	Coefficients (SE)	
	Upstream	Downstream
Irrigation water	0.45 (0.10)***	1.22 (0.25)***
Drinking water	8.43e-3 (1.82e-3)***	1.51e-2 (2.95e-3)***
Leaf litter	0.46 (0.17)***	1.18 (0.28)***
Fuelwood	5.11e-2 (1.80e-2)***	0.10 (2.83e-2)***
Contribution	-3.22e-4 (1.18e-4)***	-5.94e-4 (1.84e-4)***
Age	-2.89e-2 (1.00e-2)***	-2.03e-2 (1.68e-2)
Education	-5.43e-2 (8.03e-2)	0.15 (0.18)
Traditional house	-0.82 (0.67)	-1.07 (0.96)
Landholding	-0.22 (0.16)	-8.62e-2 (0.16)
Family size	0.20 (7.09e-2)***	-0.33 (0.13)**
Water demand	2.33e-3 (1.24e-3)*	8.67e-3 (3.73e-3)**
Male * leaf litter	-4.68e-2 (0.14)	2.07e-2 (0.15)
Irrigated land * fee	2.13e-5 (2.28e-5)	3.80e-5 (2.16e-5)*
Male * fuelwood	-1.39e-2 (1.45e-2)	-3.97e-2 (1.80e-2)**
Landholding * irrigation water	3.65e-2 (1.70e-3)**	1.86e-2 (1.51e-2)
ASC	-0.14 (0.12)	0.15 (0.19)
Standard deviation of random parameter		
Irrigation water	0.52 (0.20)***	0.86 (0.25)***

Note: *, **, *** denote statistical significance at 10%, 5% and 1% level, respectively.

On the other hand in downstream, larger family size means large irrigated landholdings and living close to community forest. This means small farmers living far from community forest suffer more from the degeneration of watershed services. The studies have shown that small farmers are more likely to invest on resource conservation when they have cash income (Reardon and Vosti, 1995; Clay *et al.*, 1996). The distance between forest and users house may affect the symmetry of relationships among resources users and their relationship with resource (Varughese and Ostrom, 2001). Users living closer to forest may have a more secure and easy access to forest products. In order to secure resources, distant users may select the alternatives with improved watershed services more frequently compared to their neighbor living close to forest.

Some socioeconomic variables have significant effect on only one location. For instance, elder people are less likely to select alternatives compared to their younger

counterparts in upstream but this variable is not significant in downstream. However, previous study in the lowland of Nepal indicated that elder people have higher Willingness To Pay (WTP) compared to their younger counterparts (Rai and Scarborough, 2015). This contrasting result could be because in recent days young people are more engaged in commercial farming close to city area. Similarly, households with larger landholdings prefer the alternatives with more irrigation water available compared to their small holder farmers in upstream. Likewise, male respondents are unlikely to select the alternatives with more fuelwood availability in downstream community.

4.3 Estimation of willingness-to-pay

WTP for watershed services is estimated in three-stages. First, marginal WTP or the implicit price of individual attributes included in the choice task. Then, WTP for specific policy options at the household level is estimated and third is the estimation of social benefits.

The implicit price of attribute k is estimated as a negative ratio of coefficients between the attribute (k) and the cost attribute (c).

$$IP_k = -\beta_k / \beta_c \dots\dots\dots 2$$

The estimated implicit prices indicate that downstream households have a higher WTP for all attributes included in the experiment, except for drinking water (Table 4). This is likely because most of the downstream households have access to piped drinking water.

TABLE 4: IMPLICIT PRICES (NPR) AND THEIR CONFIDENCE INTERVALS IN PARENTHESES

Attributes	Upstream	Downstream
Drinking water	26.14 (14.62-37.66)	25.45 (16.66-32.24)
Irrigation water	1,417.47 (842.29-1,992.65)	2,067.53 (1,479.86-2,655.20)
Leaf litter	1,430.55 (612.60-2,248.50)	1,988.35 (1,262.97-2,713.73)
Fuelwood	158.62 (72.83-244.41)	175.80 (105.71-245.89)

The change in household's welfare from implementing the proposed watershed management program can be estimated using the following formula (Hanemann, 1984):

$$CS = \frac{1}{\beta_c} [\ln(\sum_{j \in R} \exp(V_0)) - \ln(\sum_{j \in R} \exp(V_1))] \dots\dots\dots 3$$

Where, CS is compensating surplus also referred to as household WTP (WTP_{hh}), V_0 is utility in the current situation and V_1 is utility in new situation. The CS is the change in utility moving from the current situation to new scenario.

The 'status quo' situation and the proposed plan are reported in Table 1. The new *watershed management* scenario expected from implementing a watershed plan would be an additional 10 liters of water/day/household during the dry season, one additional month irrigation water, one extra basket of leaf-litter per day during the forest opening period (1 month) and one additional *bhari* of fuel wood per year.

The estimated average household WTP for the new

watershed management program is NPR. 3,268 for upstream users and NPR. 4,486 for downstream households, which is 1.37 times higher than the average WTP for upstream residents. This is reasonable since downstream household practice commercial vegetable farming that requires more irrigation water but upstream households are still in subsistence farming.

5.0 CONCLUSION

This study shades light on the implementation of non-market valuation in community forest management. The estimated value of the watershed management program not only focuses on the overall value of the forest ecosystem but also the on the WTP for each attribute. This study indicates that non-market valuation is one of the important tools in decision making, which is based on the participation of beneficiaries. The results of the DCE survey have also demonstrated the impact of socio-economic factors on the watershed management program. This can help to minimize controversy surrounding the watershed management program.

This study shows that downstream households' have higher WTP for watershed management compared to upstream household. Our results also reinforce the understanding that gender is an important consideration in assessing demand for forest products such as fuelwood and leaf litter, which may offer significant benefits to rural women. In conclusion, this study indicates that operational plans of community forest should be a part of watershed management plan. This can contribute to maintain the environment of entire landscape.

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Darwin Initiative



The Darwin Initiative was announced by the UK Government in 1992 at the Earth Summit in Rio de Janeiro. It was established as a non-departmental public body of Department of the Environment, Transport and the Regions (DETR), moving to Department for Environment, Food and Rural Affairs (DEFRA) on its formation in 2001.

The Darwin Initiative is a UK Government funding program that aims to assist countries with rich biodiversity but poor financial resources to meet their objectives under the Convention on Biological Diversity (CBD); the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and the Convention on the Conservation of Migratory Species of Wild Animals (CMS).

The scope of supported projects is very broad and includes, institutional capacity building, training, research, work to implement the biodiversity convention, and environmental education or awareness.



BirdLife International

BirdLife International is the world's largest nature conservation Partnership. Together we are 120 BirdLife Partners worldwide – one per country or territory – and growing with 13 million members and supporters, over 7,000 local conservation groups and 7,400 staff.

BirdLife's vision is a world rich in biodiversity, where people and nature live in harmony. We are driven by our belief that local people, working for nature in their own places but connected nationally and internationally through our global Partnership, are the key to sustaining all life on this planet. This unique local-to-global approach delivers high impact and long-term conservation for the benefit of nature and people.

BirdLife has nine Global Programmes - some are well established, others are more recent and responding to specific conservation issues.

In addition to the Global Programmes there are programmes specific to a region. Together these Global and Regional Conservation Programmes help the Partnership focus and work around common priorities. They provide the framework for planning, implementing, monitoring and evaluating our conservation work.

Federation of Community Forestry Users, Nepal



The Federation of Community Forestry Users Nepal (FECOFUN), established in July 1995, is a national federation of forest users across Nepal and a formal network of Forest User Groups (FUGs) from all over the Nepal. Approximately, 15000 Community Forestry Users Groups (CFUGs) and other 13000 Community Based Forest Management Groups (such as leasehold forestry groups religious forestry groups buffer zone and traditional forest management groups) in are affiliated in this Network.

As per its constitution, local/VDC level and District level FECOFUN are function under the umbrella of National FECOFUN. The national executive committee has been formed by National general assembly of FECOFUN and there is a provision of steering committee within the executive committee for day to day work. The district level FECOFUN has established in all districts of Nepal.

The FECOFUN has dedicated to promoting and protecting users rights through capacity strengthening, economic empowerment, sustainable resource management, technical support, advocacy and lobbying, policy development, and national and international networking and to uphold the values of inclusive democracy, gender balance, and social justice. It has been working with different National and International agencies and project for the benefit of forest users and promotion of natural resources.



Department of Forests

Department of Forests (DoF) is the only government agency of Nepal for the sustainable management, utilization, protection and development of forest resources outside the protected areas. The forest administration in Nepal has evolved through a series of fundamental changes reflecting to priorities of the Government. The establishment of the first Department of Forests took place in 1942; however formal forest administration was began with the establishment of Ban Janch Adda in 1934.

It is one of the five departments under the Ministry of Forests and Soil Conservation. As per current structure, the Director General (DG) is responsible for overall forest administration and presently, it has commanding over seventy four district of Nepal. DoF has been providing its services through four administrative levels: headquarters (DoF), District Forest Office (DFO), Ilaka Forest Office and Range Posts. Planning and monitoring, Community Forest, Forest Silviculture, National Forest Divisions and other 5 main section are functioning at its headquarter.

The main mandate of DoF is to manage the country's forest resources for the conservation of the natural environment and to supply the forest products to the people. So the DoF not only functions for Protection, management and utilization of forests but also devotes on Planning, implementation and coordination of forestry development activities. In addition, the DoF supports and facilitates the Ministry of Forests and Soil Conservation to formulate policies.



Established in 1982, Bird Conservation Nepal (BCN) is the leading organisation in Nepal, focussing on conservation of birds, their habitats and sites. It seeks to promote interest in birds among the general public, encourage research on birds, identify major threats to birds' continued survival. As a result, BCN is the foremost scientific authority providing accurate information on birds and their habitats throughout Nepal. We provide scientific data and expertise on birds for the Government of Nepal (GoN) through the Department of National Parks and Wildlife Conservation (DNPWC) and work closely in birds and biodiversity conservation throughout the country.

BCN is a membership-based organisation with a founding President, patrons, life members, ordinary members,

friends of BCN and active supporters. Our membership provides strength to the society and is drawn from people of all walks of life from students, professionals and conservationists. Our members act collectively to set the organisation's strategic agenda.

We are committed to showing the value of birds and their special relationship with people. As such, we strongly advocate the need for peoples' participation as future stewards to attain long-term conservation goal.

As the Nepalese partner of BirdLife International, a network of more than 110 organisations around the world, BCN also works on a worldwide agenda to conserve the world's birds and their habitats.



Bird Conservation Nepal

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