Assessing Payment for Ecosystem Services in Resunga Forest Hill, Gulmi Nepal

Indra Bahadur Prachhain[1], Bimala Khanal[2] and Ram Asheshwar Mandal[3]*

[1]Department of Forests and Soil Conservation, Nepal

[2]Kathmandu Forestry College, Nepal

[3]School of Environment Science and Management, Nepal

***Corresponding author:** Ram Asheshwar Mandal, School of Environment Science and Management, Nepal

Abstract

Payment for Ecosystem Services is always appreciated because of its offer for services receiving from ecosystem. Thus, this research was objectively carried out list of ecosystem services offered by Resunga forest hill and to show their economic analysis. Two Focus group discussion was carried out with the involvement of local people, social worker, and community schoolteacher and from related stakeholder. One focus group discussion with 10 numbers of participants was carried out at Resunga municipality. Total 15 key interviews were conducted to collect the information regarding ecosystem services using structured and semi structured questionnaire, through either formally or informally interview. Field visit was done at morning to ecosystem system services exist in the forests. Secondary data were mainly collected from published and unpublished relevant documents. The collected data were analyzed using descriptive and economic analysis. The list of ecosystem services are water, fodder, forage, pebbles/ boulders, timber and fuel wood. These services were categorized into four main categories into regular, provisional, cultural and supportive. The water was considered as the most significant services in the study area. It was found that total benefit of US$18332.54 and total cost was around US$11132.425. So, the mean benefit and cost is US$3666.508 and US$2226.48 respectively. The benefit cost (B/C) ratio was found to be 1.66 which shows that there is high potentiality of PES schemes in Resunga furthermore NPV value seems to be 1.33 which means PES schemes will have high sustainability in Next five year in Resunga forest.

Keywords: Payment for ecosystem services, Resunga Forest Area, Livelihood, Fund mobilization

Introduction

Payment for Ecosystem Services (PES) is a mechanism to improve the provision for indirect Ecosystem services in which ecosystem services providers receive direct payments from the users of the services. The basic principles of this PES are beneficiaries of Ecosystem services pay for their provision and providers of Ecosystem services get paid to provide them [1-6]. This PES scheme includes five basic components of: well-defined Ecosystem services, at least one buyer, at least one Ecosystem service in the transaction, at least one service provider, and conditionality [7]. The term 'ecosystem services' came into widespread use in the ensuing dialogue and, formalizing the term in a 1997 publication, the Ecological Society of America explained that the term ecosystem services "refers to a wide range of conditions and processes through which natural ecosystems, and the species that are part of them,

help sustain and fulfill human life [8,9]. People, companies, and societies rely on these services for raw material inputs, production processes, and climate stability [8].

Millennium Ecosystem Assessment 2005 categorized the overall ecosystem into four broad categories in which provisioning, regulating, cultural and supportive services fall under. Provisioning services includes: Wood, fuel wood, fodder, food, fiber, genetic resources etc. whereas regulating services includes: Climate regulation, Disease regulation, Water regulation, Water purification etc. similarly Supportive services includes on Soil formation, Nutrient cycling, Hydrological cycling, Primary production etc. finally cultural services includes: Aesthetic, Spiritual and Religious, Recreational services (WRI 2009) [10,11] .Resource management practices in upstream areas can have both beneficial and adverse

effects on downstream communities Smith & Katoomba et al. [12,13], Summarize that between 1999 and 2001, participating farmers converted nearly 1.2 million hectares of cropland into forest and pasture and afforested nearly 1 million hectares of land. In one of the few examples of a single-country driven PES for global public goods, Mexico in 2004 designed the Payments for Carbon, Biodiversity and Agro-forestry (PSA-CABSA) program. The program was later combined with the much larger Payments for Hydrological Services program, whose funding is predicated on providing public goods whose main beneficiaries are within the territorial boundaries of Mexico.

Nepal is trying to implement schemes on payment for ecosystem services. About a dozen of PES schemes have been successfully implemented in Shivapuri, Kulekhani, Rupa lake, Dhulikhel, Dolakha and Kanchanpur in Nepal [8,14]. To overcome challenges and for smooth implementation, recently Government of Nepal has identified and legalized ecosystem services from amendment of Forest Act 1993. Similarly, through Forest Policy 2015, GoN has emphasizes on the strengthening the PES to leverage funds as a potential viable approach for Nepal [14]. The ecosystem services and income generated from Resunga Community Forest is unknown, thus this study was objectively carried out to list out the ecosystem services and estimate the income generated.

Materials and Methodology

Administratively district Gulmi is one of the sixth district of Lumbini Zone, which is situated in Western Development Region and one part of the province no. 5 of Nepal. It is one of the hilly districts and covers a total area of about 1149 km^2 (107918.2 ha) and had a population with 280,160 which is 1.2 percent of country's total [15,16]. The average population density is found to be 243/km2 and population increase rate with -0.4 percent. According Nepal human development report 2014 this district is ranked with the value 0.464. Location of Downstream users is shown in Figure 1.
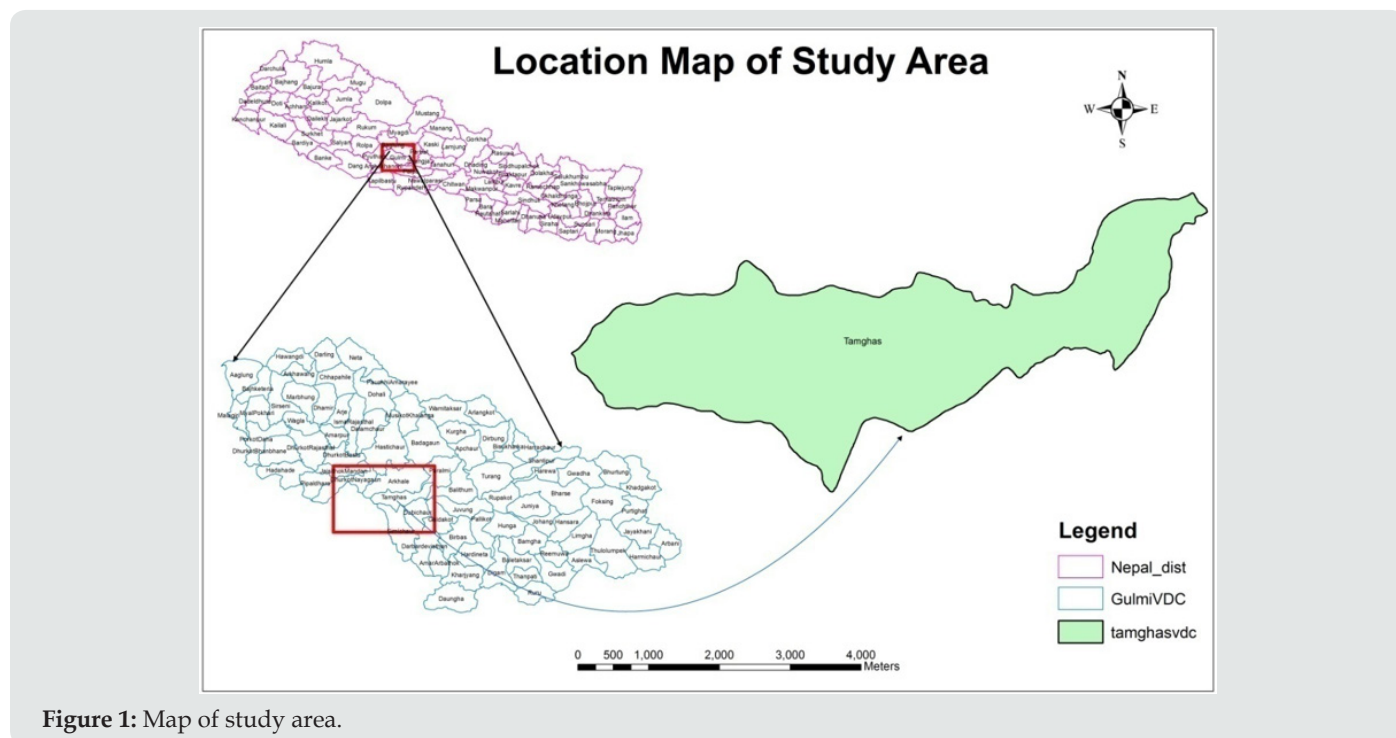

Figure 1: Map of study area.

Sampling Design and Sample Intensity

For the data collection from the study site, simple random sampling design was chosen to carry out field survey. Out of 1202 household are belonging from four community forests (i.e. Bhalupatal CFUG, Sivasakti CFUG, Resunga CFUG, Nawajiwan CFUG), all total 758 Households are selected for primary data collection on household survey, with the sample intensity of 12% (>10%).

Focus Group Discussion

Two Focus group discussion was carried out with the involvement of local people, social worker, and community schoolteacher and from related stakeholder. One Focus group Discussion with 10 numbers of participants was carried out at Resunga municipality.

Key Informant Interview

Total 15 key interview was conducted to collect the information regarding ecosystem services. Here by some structured and semi structured questionnaire, either formally or informally interviewed to relevant topics expertise. This sort of interview was done to analyse qualitative data analysis with current and ex DFOs, freelancer, working organisational persons and senior researcher.

Field observation

To verify the information obtained from social survey and quantify ecosystem services provided by the Resunga forest hill and to manipulate Upstream and Downstream level beneficiaries. Floral (including Timber and Non timber) and faunal assessment were observed during field visit. This visit was conducted at morning by using appropriate security. A co-helper, who can explain about the situation analysis of forest biodiversity, an observation was carried out.

Secondary data

Secondary data were mainly collected from published and unpublished journal articles, relevant CFs operational plan, District Forest Office-Gulmi, Bird Conservation Nepal, Ruru-Resunga Office, Office of Drinking water and Sanitation Gulmi, DDC Gulmi, KAFCOL Library, related INGOs and NGOs website etc.

Data analysis

Descriptive analysis was done to analyze the collected data regarding ecosystem services. At the same time, benefit or loss, Net Present Value (NPV) and Benefit cost ratio was calculated using following formulae given below:

$$NPV = \text{Total present value} - \text{Total management cost}$$

$$= \left[\frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \cdots + \frac{CF_n}{(1+r)^n} \right] - \text{Total management cost,}$$

B/C = Benefit/Total management cost

Benefit = Total returns – Total management cost;

Loss = Total management cost – Total returns.

Spatial data were analyzed and outputted by using software Arc GIS 10 was used to prepare map of study area.

Results and Discussion

Potential Ecosystem Services Offered by Resunga Forest Hill

Diversified forest product and services with all types of ecosystem services are classified according to MEA, 2005 [17]. These categorized ecosystem services are presented into following (Table 1). These are: Timber, fuel wood and are the provision services.

Table 1: Services of Resunga forest hill and its uses.

Types	Services	Uses
Provisioning Services	Timber	Construction
	Firewood	Cooking and heating
	Clean water	Drinking and irrigation
	Leaf litter	Cover for livestock
	Grasses	Food for livestock
Regulatory	Water purification	Pure water
Cultural	Tourism	Importance
	Religious	Importance
Supporting	Habitat, Ecosystem, Biodiversity	Promote sustainability

Ranking of Ecosystem Services: During my study in Resunga forest hill it was found that there are many ecosystem services. Of which water has got high priority among all ecosystem services. Water has got six votes, firewood has got four vote, tourism has got three vote, timber has got two vote, grasses has got three vote, leaf litter has got one vote and religious importance has got single vote from the respondents during household survey. Resunga is a place which has provide many services and has potential for ecosystem service of which people living around Resunga are being benefitted by services (Table 2).

Table 2: Ranking of ecosystem services using pair wise ranking method.

Services	Water	Firewood	Tourism	Timber	Grasses	Leaf litter	Religious	Value
Water		Water	Water	Water	Water	Water	Water	6
Firewood			Tourism	Firewood	Firewood	Firewood	Firewood	4
Tourism				Tourism	Grasses	Tourism	Religious	3
Timber					Grasses	Timber	Timber	2
Grasses						Grasses	Grasses	4
Leaf litter							Leaf litter	1
Religious								1

Potentiality of Payment for Ecosystem in Resunga Forest Hill: From the study it is found that total benefit of Five-year trend incomes seems to be US$ 18332.5 and total cost US$ 11132.425. The mean benefit and cost were US$ 3666.508 and US$ 2226.48. The amount of water used by users of four CFs is; 276800 litre daily and 8304000 Litre monthly and the amount is US$ 174894.69 monthly (1000 litre =US$25.27).The income is exceeding over the expenditure so PES schemes seems to be sustainable in Resunga with high potentiality (Table 3).In same way B/C ratio due to benefit and cost was found to be 1.66 which shows that there is high potentiality of PES schemes in Resunga furthermore NPV value seems to be 1.33 which means PES schemes will have high sustainability in Next five year in Resunga forest.

Table 3: Ranking of ecosystem services using pair wise ranking method.

Community Forests	BC ratio	NPV	PI	Remarks
Nawajiwan	1.48	0.3	0.15	
Resunga	2.04	0.59	0.43	
Shivashakti	1.41	0.28	0.13	
Bhalupatal	1.4	0.15	0.06	

Discussion

Resuga Forest Hill can be considered as a full package with the verity of ecosystem services. Growing human population and changing life standard has created more threats on the natural existence of environmental services. Similarly, a crude ecosystem services and goods are transformed and counted into monetary transaction. A monetary transaction of ecosystem services will only possible if there is a proper accounting the volume of ecosystem services. This research concludes the data base of such ecosystem into major groups of Provisioning services with Timber from broadleaved and coniferous woody species, Resin from major Pinus species, firewood from cultural operation at forest areas consists of twinges and branches, and grasses like surface grasses and fodder grass. Similarly, regulating services like water demand will be cured by Water purification by different water sources (mul) such as Bhagerikhola, Oknexera, Seti, Maghim, Charikhola, Toonikhola are the main watershed which connect upstream and downstream dwellers for living and non-living beings' natural existence. Additionally, air purification and carbon sequestration will ensure for biodiversity conservation and healthy ecosystem. Cultural services include with religious importance temple with famous Resunga temple and nearby holy ponds, different god and goddness statue, Tourism and recreation services for youth and traveler. Again, Supportive services such as soil carbon sequestration, Soil formation, nutrient cycling water purification hill enhance living existence at natural environmental services.

Main pair wise ranking on ecosystem services shows that the high dependency on water services, followed by, firewood, tourism respectively. This shows that main substance includes pure water for living beings at urban areas. Again, a research by Rai et al. [18]., shows that Sundarkhola sub watershed is similarly important for a water providence services to Dharan Municipality of eastern Nepal. The further importance service of Resunga hills on firewood implies that there is still importance and use of firewood as a major fuel wood. A fuel wood occupies more than 70 percentage of cooking fuel towards Nepalese household. Similarly, a pair wise ranking on tourism shows that its importance towards recreational purposes. Tourism is considered as one of major sector of contributing on National GDP. Almost Government of Nepal is collecting a 5 percentage of GDP contribution from forest areas of Nepal.

Finance is one of the key pillars of sustainability. It includes income, expenditure and monitory saving, which are also the market mobilizing parts of money. Similarly, income and expenditure trend of 4 CFs support in average shows that it has a 360 US$ of saving annually by per CF. The highest most income was obtained by Resunga Community Forest whose Profit index; Benefit Cost Ratio was 0.43 and 2.04 respectively. BCR =1.66, NPV=1.33 was obtained from Resunga, Nawajiwan, Shivashakti and Bhalupatal CF. The potentiality of payment of water utilized from Resunga was found to be 174894.69 US $. This estimation was according to use of water by respondents and amount was calculated by considering tanker costs (1200l= US$ 25.27). The similar research by Rai et al. [18] shows that there will 118,000 US $ of flow of financial water contribution of Sardukhola watershed of Dharan Municipality of eastern Nepal [19-24]. Again, PES scheme conducted at Shivapuri Nagarjun site enhance the possible PES institutional setup for the Sundarijal catchment area [25-29]. Environmental benefits are also needed toe identified and valued properly to convince the decision makers about importance of managing upper catchments as a part of water supply infrastructure [30-35]. The successful implementation of PES largely relies on the participation of state and/or community [36,37].

Conclusion and Recommendation

A package of ecosystem services such as provisioning services by providing Timber, Resin, firewood, grasses etc., regulating services by offering Water purification, carbon sequestration and air purification for ecological balance, Cultural services by Religious importance, Tourism and Recreation facility, Supportive services by Soil formation etc. These package services show towards beneficial on downstream people main preferred service was water, firewood, grasses by these people. The financial analysis of different CFs shows the value of B/C, NPV and PI has highest from Resunga CF with 2.04, 0.59 and 0.43 respectively. Again, a trend of income and expenditure of Resunga CF was found to be highest. Ecosystem potentiality is also needed to be identified and valued properly to attract the both conservator who receive the payments for conservation and polluters who pay for the utilization of ecosystem services.

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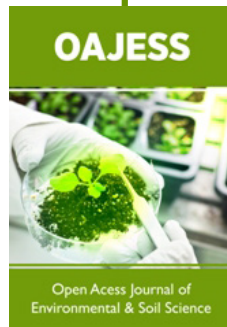
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