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ECOSYSTEM SERVICES AND ITS MAINSTREAMING IN DEVELOPMENT PLANNING PROCESS

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Abstract

Forest and wetland ecosystems play a significant role in local livelihoods by providing wide range of goods and services. Yet, forest and wetland ecosystems are under threat due to overexploitation and degradation of catchments. Globally, various studies of forest and wetland ecosystem services have been conducted. The present study on 'Ecosystem services and its mainstreaming in development planning process' was focused to update the latest developments in methodologies, data needs and applicability of economic valuation of ecosystem services; and use the existing knowledge to build capacity of field staff in application of ecosystem services approach for promotingsustainable resource management. The target area comprised Asan Conservation Reserve, which is the first Ramsar Site in Uttarakhand state. An assessment of selected ecosystem services of Asan wetland was undertaken by targeting four nearby villages using direct valuation of selected provisions (viz. fuelwood, fodder, bedding leaves, NTFP, fish, tourism, elephant grass) as well as indirect valuation (i.e. carbon sequestration, soil nutrients, biodiversity conservation). Also capacity building measures of field staff of forest departments was taken up for creating awareness on ecosystem services and payment of payments for ecosystem services (PES). Also, a training manual for evaluating forest and wetland ecosystem services was prepared. Some suggestion related to mainstreaming ecosystem services in the policies and practices have been provided.

Key word: Ecosystem,Wetland, Forest,Ecosystem Services,Ramsar site

Introduction

Ecosystem services are acquired interests provided by the ecosystem to enhance human lifestyle. The distinguished kinds of ecosystem dispense wide array of goods and services. This includes terrestrial ecosystem, forest ecosystem, wetland ecosystem, grassland ecosystem, freshwater ecosystem, marine ecosystem, etc. Thus, the good and services supply from such diverse ecosystems impact the anthropogenic existence. Wetland and forest ecosystem services, productive and diverse, are inclined more towards the socio economic value. There are large number of studies have been carried out worldwide who reveal the annual value of goods and services from a wetland to be second highest(Goodland, R.1995, Haines-Young &Potschin 2010, Brauman et al. 2020). In recent years, there is an increasing trend to use ecosystems services in developmental planning as well (MA 2005, IPCC 2014, FAO 2017). However, despitesupporting and maintaining diverse ecosystem services that are key for livelihood, wetland and forest are under immense threat globally.

India, a diverse country, constitutes different types of Forests and magnificent wetlands. The estimation of the wetland area extent varies from lowest 1% to highest 5% in Indian geographical area. (Space Application Centre, 2011). The Indian State forest report (IFSR, 2019) clearly mentions the forest extent to be 8,07,276 square km which is 24.56 % of the total geographical area. Uttarakhand is blessed with 116 documented wetland (Uttarakhand Forest Department and WWF, 2012) out of which Asan Conservation Reserve is situated in the foothills of Himalayas in Uttarakhand.

Sustainable use and management is important for the wellbeing of humans. Poor realisation of value of wetland and forest ecosystems creates improper management of these vital resources. The economic value of indirect services should be focused to increase the efficiency of sustainable use and management of ecosystem (Baral, 2016). The main objective of this study are to update on latest developments in methodologies, data needs and applicability of economic valuation of ecosystem services, to increase capacities of technical and field level staff that are involved in implementing practical actions for natural resource management at field condition, to promote sustainable resource management approach and take the benefit of payments for ecosystem services (PES), and to upgrade existing knowledge and skills on the application of economic valuation of ecosystem services. Other than having a detailed literature review on

ecosystem services the Asan wetland in Asan Conservation Reserve in Uttarakhand was selected to collect field data related to goods and services provided by the lake and its economic evaluation along with socio economic status and dependence of local villagers on the wetland. It is expected that the information would not only update knowledge on the subject but also help in planning and management of Asanlake.

Material and methods

STUDY AREA

The Asan Conservation Reserve (ACR) comprises a freshwater wetland ecosystem at the confluence of two prominent rivers Yamuna and Asan near Dhalipur Village of Vikasnagar Block in Dehradun District, Uttarakhand. The lake spreads over an area of 444,40 hectare. It supports a wide variety of Flora and Fauna. This site is known for the migration of international bird species. The Asan Reservoir is the manmade wetland constructed in 1967 with the submergence of low lying areas. Asan barrage of Doon valley was designated as Ramsar Site in 2020. The agencies which use or control the Asan Conservation Reserve (ACR) are Uttarakhand JalVidyut Nigam Limited (UJVNL), Forest Department (Chakrata and Kalsi Division), Forest Development Corporation, Tourism Department (Garhwal MandalVikas Nigam). According to Ramsar Report (2020), 330 species of birds have been observed at Asan. The statesman report of January 31, 2021 states there has been increase in number of migratory birds. 899 Eurasian Coot, 852 Ruddy Shelduck, 764 Red-Crested Pochard, 525 Eurasian Wigeon and other bird species were spotted during the winters of 2021. Furthermore, these species are globally or internationally threatened or included in CITES Appendices and/or IUCN Red List. Summary characteristics of the villages surveyed have been given in Table 1.

Table 1: Broad features of investigated villages in Asan conservation reserve area, Uttarakhand

	Dhalipur	Kunja Grant	Kunja	Matakmajri
Latitude	30°26’13”N	30°25’08”N	30°25’09”N	30°24’56”N
Longitude	77°41’20”E	77°40’12”E	77°39’26”E	77°37’48”E
Altitude (in m)	430	489	500	492
Population percentage (Census 2011)	32	24	24	20
Total number of Household	609	390	440	396
Number of household surveyed	60	39	44	39

Household percentage (According to Census 2011)	33	21	24	22
Male percentage (According to Census 2011)	33	22	24	21
Female percentage(According to Census 2011)	33	22	24	21

Figure 1. Aerial view of Asan wetland, Uttarakhand (Image source: Google Earth)

Methodology

Direct Ecosystem Goods and Services include fuel wood, fodder, bedding leaves, minor forest produce, fish and tourism of forest and wetland. Indirect Services comprised of Soil Nutritional Value and Biodiversity Conservation. For direct use value a total of four villages, viz. Dhalipur, Kunja, Kunja Grant and Matakmajari were considered for evaluation of ecosystem services. Household Survey considering 10 percent of the population of each caste, category, religion and other groups had been conducted in four villages named as Dhalipur, Kunja, Kunja Grant and Matakmajri. 182 households had been surveyed to collect data regarding forest and wetland goods and services. Questionnaire based survey was carried out by random Sampling method. Revealed Price method of Valuation was used to assess the Direct Goods and Services of Forest

and Wetlands. The assessment value of fodder/ fuel wood/ bedding leaves/ NTFP was calculated from the following formula:

Total Value (in INR) = Total number of Head loads per year X Average weight of fuel wood/ fodder/ bedding leaves X Market rate (Negi et al 2015, Community Training Manual)

The value of Fish and NTFP had been computed by the Total Quantity consumed per year multiplied by Average market rate. Table 2 represents the types of methodology used to compute the overall Forest and Wetland goods and services.

Indirect Use Values- Contingent Valuation Method and Revealed Valuation Method have been used for Soil Nutritional Value and Biodiversity Conservation respectively. Table 2 represents types of values and methods of valuation of forest and wetland ecosystem services of Asan Conservation Reserve (ACR).

Table 2: Types of values and method of valuation of forest and wetland ecosystem services

Types of ecosystem services	Values	Types	Method of valuation	Source of data collection
Forest	Direct	1. Forest goods Fuel wood, Fodder Bedding Leaves, NTFP(Buds and Calyx of *Bombaxceiba*)	Revealed Price Method	Household Survey
	Indirect value	C- Sequestration Soil nutritional Value	Replacement cost method Contingent Valuation method	Badola (2010) Cost of manure
Wetland	Direct	1.Wetland goods like fish 2. Tourism	Revealed Price Method Revealed Valuation Method	Household Survey Government Enterprise(GMVN)
	Indirect	3. Biodiversity Conservation in wetland	Revealed Valuation Method	The Forest Department

Results

Developments in methodologies and applicability of ecosystem services

A detailed literature review was undertaken to assess latest developments in methodologies, data needs and applicability of economic valuation of ecosystem services (Costanza et al. 1997, 2017, Villamagnaet al., 2013, Liu et al.J., 2015, Spangenberg et al. 2015, Díaz et al., 2019). It is described that ecosystem services comprise all outputs, conditions, or processes of natural systems that directly or indirectly benefit humans or enhance social welfare. They are not usually bought and sold directly in markets. It evaluates consequences of ecosystem change and its impact on human & social welfare.Ecosystem services analyses is desired to promote policy decisions(Bateman et al. 2011). The history of concepts and methods reveals valuation of services exists for long- promoted by environmental & resource economists. Since 1970- the concept of "ecosystem services" emerged and gained increasing recognition (Costanza et al. 1997). In past 2-3 decades ecosystem services analyses in monetary terms paid greater attention (Daily et al.,2009, de Groot et al. 2010, Collins et al. 2015). It describes complex relationships between ecological and socioeconomic systems, and how changes in those relationships affect human welfare. There are different approaches / methods / models to quantify the different types of services.

For identification, quantification, and valuation, two broad criteria distinguish ecosystem services from other ecosystem conditions or processes, i) An ecosystem service must be linked to an identifiable set of human beneficiaries (direct or indirect), and ii) Physical and institutional access constraints must not prevent people from realizing those benefits. It is reported that the conditions or processes of ecosystems that cannot be linked to the welfare of identifiable beneficiary groups are generally not considered ecosystem services. The major steps in ecosystem services assessment comprise a clear-cut identification of the ecosystems and the services to be evaluated, and thereafter quantify one or more of the servicesidentified (links between human actions and ecological effects and the subsequent changes to ecosystem services). There is also a need to determine the consequences for social welfare using formal economic valuation methods.

Methods and approaches used in valuation of ecosystem services

An assessment of various methods to measure ecosystems services revealed that they vary from economic, human perception, and modelling to combinations among these assessment approaches. Some common methods are **Contingent valuation-** a survey-based method of determining the economic value of a nonmarket resource (natural and environmental resources) used to estimate the value of resources and goods not typically traded in economic markets, and **Travel cost method** (TCM) a substitute market approach technique for valuing ecosystems or environmental resources based on the costs that people are willing to pay to visit an ecosystem as an expression of its recreational value. There are also other methods, such as Hedonic Pricing Method (HPM), Replacement cost, Choice modelling (CM), Market price, adverting behavior, and random utility model. Over the years there ismore attention to integrating stakeholders' perspectives and aligning the results with policy needs. It is suggested that an integration of different methodologies is required to assess ecosystem services of any ecosystem. And, there is a need to develop **a regional strategy** to facilitate cooperation from all sectors and build the capacity of officials and other stakeholders to ensure greater reliability and policy uptake of future ecosystem services assessment.

Himalayan context: Payment of Ecosystem Services

Since 2005, 10 Himalayan states demanded a '**green bonus**' from Govt. of India for keeping critical ecosystems intact (1/3 of country's forest cover 'lies in IHR and considered India's major carbon sink; over 60% water flows in India's river contributed by Himalayan rivers) that triggered the payment for ecosystems debate. It is estimated that the value of forest ecosystem services flowing from Uttarakhand calculates as $2.4 billion / year (Rs 10,700 crore/ year), and at the Indian Himalayan region level, it is Rs 94,300 crore / year (CHEA report). An estimate of forest carbon pool in Indian Himalaya is about 5.4 billion tonnes (forest biomass + forest soil), which is about equal to the annual carbon emission from fossil fuels in Asia. It is reported that annually, 1200 billion cubic metres of water flow through the Himalayan rivers. The 12th Finance Commission (2005-10) came with a formula to incentives based on their forest coverand earmarked Rs 1,000 crores for five years but the challenge is how to monetize the ecosystem's services to be compensated to the states. The 13th Finance Commission (2010-15) allocated Rs 5,000 crore, based on the area under forest cover with an added parameter of Canopy density.

The 14th commission (2015-20) reformed the revenue-sharing formula between the Union and the states that brought the landmark change of including forest cover as a determining factor in a state's share. So far, varied estimates were made on the value of ecosystem services from different states, although these states are getting a small amount despite of rich forest cover.

The status of ecosystem valuation in IHR states revealed that Himalayan region provides crucial ecosystem services (ES) to their inhabitants and to the surrounding lowland populations. However, fast rate of urbanization, population growth, landuse change, agricultural expansion, forest degradation, degradation of natural resources, climate change, etc. impacting supply of ecosystem services. The 'green bonus' demand by Himalayan states as a means of payment for ecosystem services is valid as well as an ecological necessity to protect forests and ecosystems, and ensure life-saving services to the country, as the region face numerous restrictions in their usual development works because of its environmental consequences. There is a greater need to value services of varied ecosystems and resources, and formal use of information on ecosystem services to guide public and private decisions.

Valuation of ecosystem services of Asan wildlife sanctuary (wetland)

For the purpose of this study, the Asan Conservation Reserve (abird sanctuary) having and area of 4 km^2 and a length of 287.5 m, was considered. At is situated between 30°26'17" N and 77°38'28"Eand fass40 km west of Dehradun, the capital town of state of Uttarakhand. For assessing ecosystem services a total of four villages were targeted, viz. Kunja, Kunja Grant, Matakmajri and Dhalipur. The demographic details of the villages are provided in Fig 2.

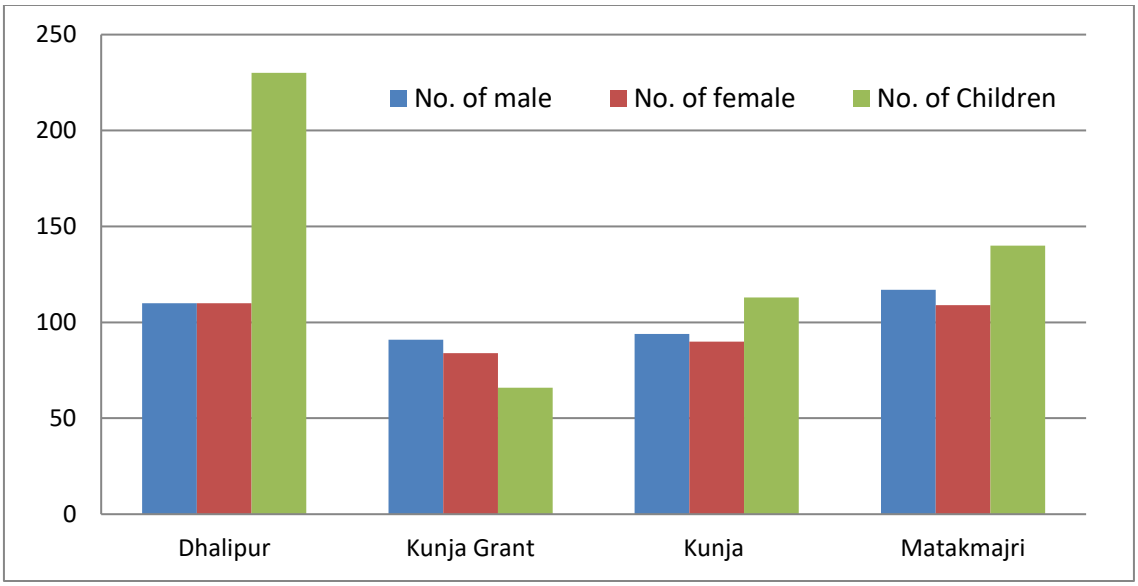

Figure 2. Population characteristics of four investigated villages

The study conducted in four villages concluded 51.18 % male and 48.8 % female as sex ratios. The total numbers of children were 549. Figure 1 represents the demographics for four surveyed villages and table 3 shows the number of male, female and children respectively. Education profile is an important component of socio economic structure of any area under research. The four villages namely Dhalipur,Kunja, Kunja Grant and Matakmajri have shown significant variation in the pattern to pursue education. Kunja Grant has 28 percent of primary educated people followed by Kunja, Dhalipur and Matakmajri. 28% people of Matakmajri had attended the middle school while solely 14% people of Kunjahad been witnessed to pursue education from middle school. The declining graph from secondary, senior secondary, UG and PG had been observed as given in figure 2. The percentage of illiterates in the four villages has been considerate enough to understand the overall educational status of the surveyed villages. Kunja Grant has 28% of illiterate, Dhalipur and Matakmajri stands equal in percentage i.e. 23% followed by 24% illiterate in Kunja respectively.

Table 2. Details of male, female and children in four surveyed villages

Name of the villages	No. of male	No. of female	No. of Children
Dhalipur	110	110	230
Kunja Grant	91	84	66
Kunja	94	90	113

Matakmajri	117	109	140

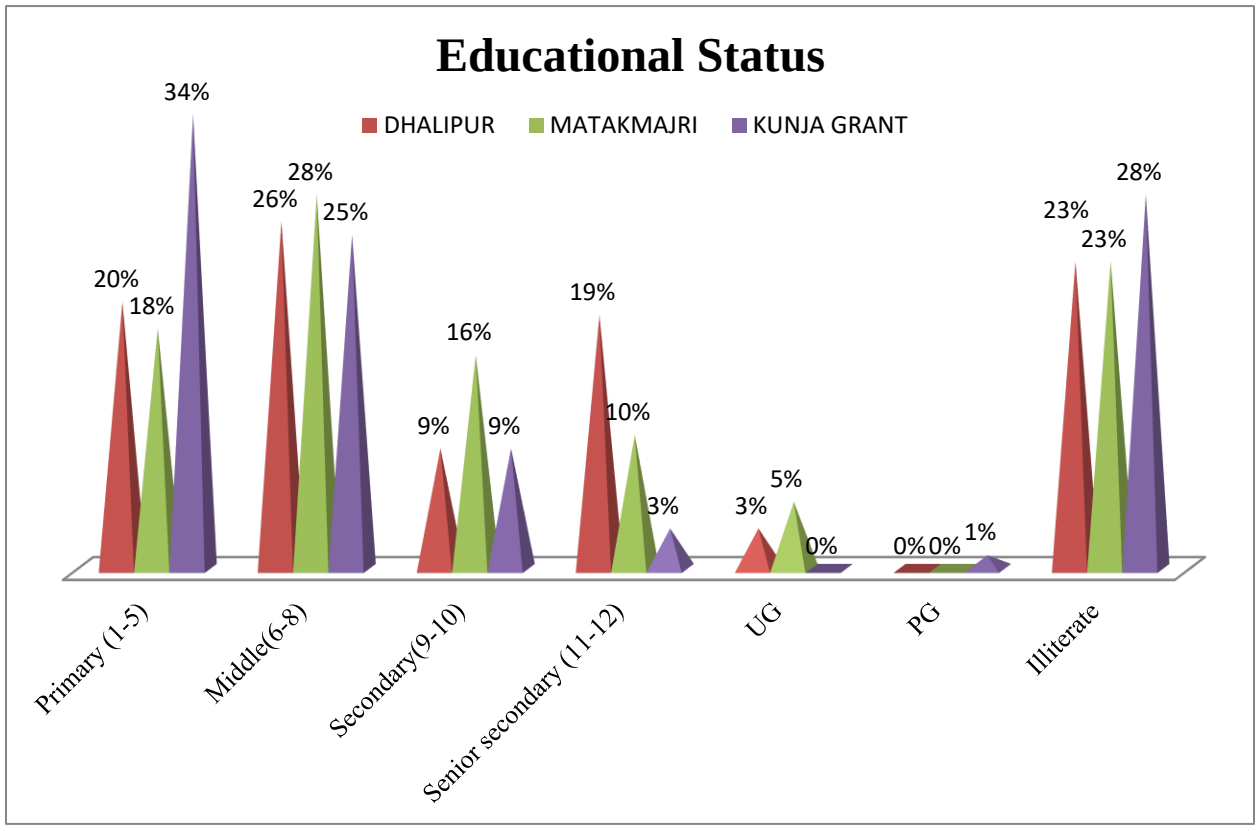

Figure 3.Educational status of four villages of Asan Conservation Reserve (ACR).

The maximum number of Other Backward Classes (OBC) was present in Kunja Grant followed by Dhalipur, Kunja and Matakmajri. Matakmajri revealed maximum number of Schedule Tribe (ST) i.e. Boksha community while minimum number of ST had been witnessed in Kunja Grant.

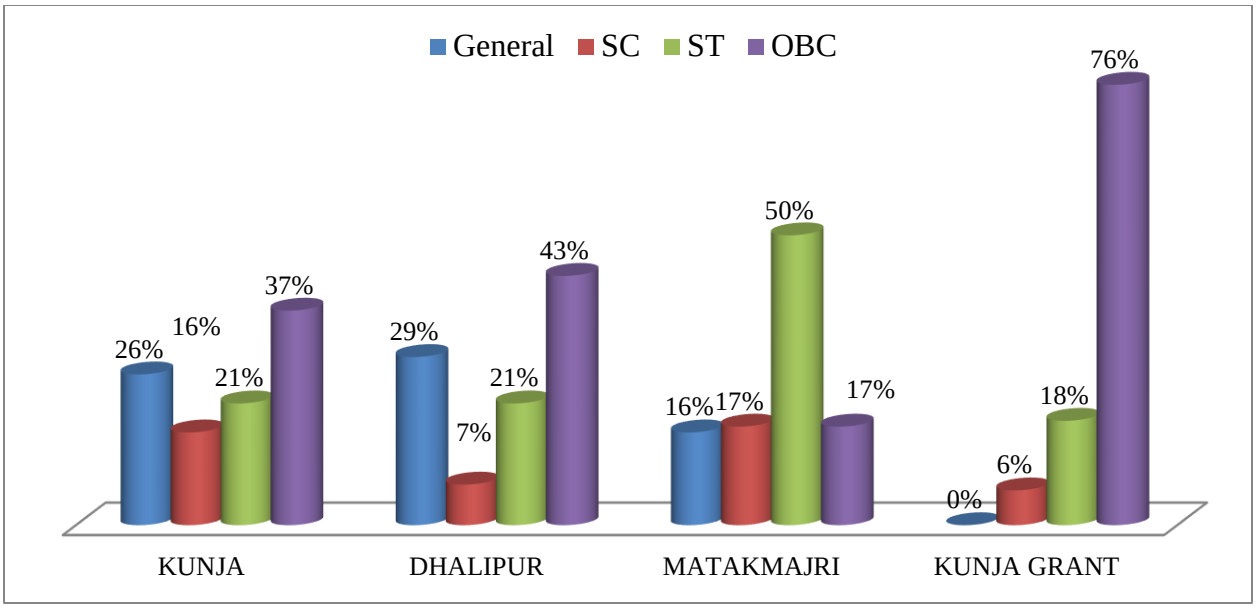

Figure 4. Caste structures of four surveyed villages

Boksha Community are native to Uttar Pradesh and Uttarakhand states of India (Farswan 2017). Dehradun and Nainital districts are their hubs of inhabitation. 1 % population of SC has been observed in Kunja whereas no population of unreserved category (UR, General) was witnessed in Kunja Grant. All the four villages show the diverse caste structure. Thus, this result exemplifies unity in diversity due to presence of different lingual communities. Hindus, Muslims and Christians were present in the four villages. Yet, the presence of Hindus and Muslims was considerably higher as compared to the any other religion. Figure 3 represents the caste structure of four villages.

Occupation and Land Holding- Occupation and land holding reveals the economic wealth of any given area. The main occupation was labour followed by agriculture, business and other occupations. The Government and Private employees had been witnessed in Dhalipur and Kunja Grant with 8% and 6% respectively. Table 5 reveals the occupational structure of the villages.Kunja and Kunja Grant had 31% of land holdings while 28 % of land was being hold by Dhalipur. 10 % land holding of Matakmajri reveals the least percentage of presence of marginal farmer. The fragmented agricultural land was prominent in these four villages.

Occupation	Dhalipur (%)	Kunja(	Kunja	Matakmajri

		%)	Grant (%)	(%)
Agriculture	17	10	22	33
Labour	59	58	61	50
Business	8	32	5	17
Government Service	8	0	6	0
Private Service	8	0	6	0

Table 3.Occupational structure of the villages nearby Asan wetland

Assessment of Ecosystem Services ofAsanwetland

Forest and wetland ecosystem services were the two types of Ecosystem Services considered for study in Asan Conservation Reserve (ACR). Major goods and services collected fromAsan Conservation Reserve (ACR) as well those prioritise for valuation are presented in the Table 5.

Table 5. Good and services used from Asan Conservation Reserve(ACR).

Area and valuation technique	Forest goods and services being used by communities	Prioritized Forest goods and services surrounding the wetland
From forest areas:		
Direct Use value (Good and Services Consumed directly- Natural resource harvesting)	Fuel wood, Fodder, Bedding leaves, Poles NTFP, *Tinosporacordifolia, Bombaxceiba* (buds and calyx), *Terminaliachebula,* Bamboo for fencing, *Aeglemarmelos*(bel), Bhabhar grass (*Eulaliopsisbinata),* *Zizypus* sp.(ber), *Syzygiumcumini* (Jamun)	Fuel wood, Fodder Bedding leaves, *Bombaxceiba* (buds and calyx)
Indirect Use Value	Soil nutrition	Soil nutrition
From Asan lake:		
Direct Use value	Fish, Tourism, Roofing material, Fodder grass, Building material, Birds/ Duck	Fish, Tourism, Roofing material (*Typhaelephant*-Elephant Grass)
Indirect Use Value	Ground water recharge, Biodiversity conservation, Carbon Sequestration, Livestock Bathing, Washing clothes, Flood control, Landslide control, Swimming	Biodiversity conservation

Prioritized goodssuch as fuelwood, fodder, bedding leaves and NTFP collected from the forest wereundertaken for the valuation assessment. The maximum number of fuel wood collection was carried out during winters followed by summer season. Rainy season witnessed the least amount of fuel wood collection. Presence of mosquitoes and snakes during winters hinders the collection

of fuel wood by villagers. As per the household survey, the total number of visits to the forest by the villagers in a year was 72 in Kunja Village. 24 persons as per the primary data were involved in the fuel wood collection which represents 10 percent of the population of Kunja Village. 1 Head load per person was collected. So, the total number of head load in Kunja village collected per year was 72x24x1= 1728. The average weight of head load of fuel wood was 35.5 kg and the market rate of fuel wood per headload during the time of survey was Rs150/-. Therefore, total value per year (in INR) would be 92,01,600 INR.

In case of Kunja Grant, the total number of visits to the forest in a year was 80. 30 persons were involved in fuel wood collection in which 15 were male and 15 were females respectively. 1 head load per person has been same in case of all the villages. Total value per year was 127,80,000 INR

Dhalipur involves 16 persons visited to the village for fuel wood. Total number of visits in a year were 60. So the total value would be equal to 51,12,000 INR.

In Matakmajri, 50 persons collect fuel wood from the forest and the number of visit was 90 in a year. So the number of Head loads collected in a year would be 4500. Total value of fuel wood would be 239625000 INR Therefore total value of fuel wood collection was 26,67,18,600 INR as shown in Table 6.

Table 6.Extraction of fuel wood and its valuation by the household of four villages.

Name of the village	Total number of head loads collected per year (HL/ year)	Average weight of head load of fuel wood (Kg)	Local Market Rate (in INR)	Total value per year (in INR)
Kunja	1728	35.5	150	9201600
Kunja Grant	2400	35.5	150	12780000
Dhalipur	960	35.5	150	5112000
Matakmajri	4500	35.5	150	239625000
Total				266,718,600

For fodder purposes, the leaves of Sal, Kachnar, Dhamnu, Sandan, Malijan etc. are collected during winters for fodder. The self-sufficiency for fodder during summers and rainy seasons was noticed due to cultivation of fodder (*Trifoliumalexandrium*) by the villagers. Grazing was also carried out.

In Kunja village, the total number of head load of fodder collected per year was 1900 and one head load per day of fodder has been collected by villagers Average weight of fodder was 25 kg. The online market price of 1 Kg fodder as per Indiamart site is 4.5 INR Therefore the market price of 25 kg fodder would be 4.5x25= 112.5. Therefore the total value of fodder computed equals 5343750 INR.

Total number of Head loads of fodder collected per year in Kunja Grant Village was 1275. Average weight of head load of fodder and online market rate has been same for every village. Therefore the total value of fodder consumed was calculated as Rs. 385837/-.

Dhalipur has been an urban village. So, the population of cattle was low as compared to the other villages.. The total number of head load of fodder collection per year was 525. So, the total value of fodder consumption in Dhalipur Village per year equals 1476562.5 INR.

The number of head loads of fodder collected in Matakmajri was 2450. Average weight and market rate of fodder is equivalent to other villages.Thus a total value of 6890625 INR. Therefore, the total value of fodder consumption per year by four villages was 17296875 INR. Table 7 represents the calculations of total cost of fodder in the four surveyed villages of Asan Conservation Reserve (ACR).

Table 7: The calculation of total value of fodder from the forest in Asan Conservation Reserve (ACR)

Name of the village	Total number of head loads of fodder collected per year (HL/ year)	Average weight of head load of fodder (Kg)	Online Market Rate (in INR)	Total value per year (in INR)
Kunja	1900	25	112.5	5343750
Kunja Grant	1275	25	112.5	3585937.5
Dhalipur	525	25	112.5	1476562.5
Matakmajri	2450	25	112.5	6890625

Collection of bedding leaves was done for domestic animals during winter season. Nearly 10 to 15 kg of bedding leaves was required per householdthat lasts for a week and used for four winter months. Subsequently such material is used as manure. It was recorded that nearly 20, 15, 7 and 25 persons from Kunja, Kunja Grant, Dhalipur and Matakmajrivillages were involved in collecting bedding leaves. As mentioned above that people change the bedding leaves after every week during winter seasons. Thus on an average a total 16 bed load were collected by each

household. The dry paddy straw was also used for bedding purposes. On an average rate of Rs 2 per kg of bedding leaves thetotal value of bedding leaves for four villages is estimated Rs. 335000 per year (Table 8).

Table 8: Valuation of bedding leaves from the forest in Asan Conservation Reserve (ACR)

Name of the village	Total number of head loads of bedding leaves collected per year (HL/ year)	Average weight of head load of bedding leaves (Kg)	Market Rate (in INR) 1Kg=2 INR	Total value per year (in INR)
Kunja	320	12.5	25	100000
Kunja Grant	240	12.5	25	75000
Dhalipur	112	12.5	25	35000
Matakmajri	400	12.5	25	125000

Valuation of selected NTFPs was also undertake. Collection of buds and calyx of*Bombaxceiba* (Semal) known as red silk cotton tree, was done for vegetable purposes (Semaldoda). The total quantity of semaldoda consumed by the four villages was estimated as 45.4 kg per year that has a market rate of Rs40 per kg. Therefore the direct value of consumption of bombax calyx and buds is 45.4 x 40 = 1816 INR

The cost of soil nutritional value was calculated using contingent valuation method.The rate of organic manure was 10 Rs per kg (Source: Indiamart)and Avg. dose required to fertile the land was 105 kg/acre. Asan Conservation reserve was 444.40 hectare of land which is equivalent to 1098.1 acres. The total cost required to fertile Asan reserve would be 115300.5 INR Therefore, the above calculated cost would be used to provide soil nutrition in Asan Conservation Reserve (ACR).

Ecosystem Services provided by Asan wetland comprisedfish, tourism, and roofing materials wereassessed through direct valuation method, while biodiversity protection represents the indirect value of wetland ecosystem services. Fish collection was a major source of livelihood for local residents around the wetland. Fish is main source of nutrition to marginal households in the region. The market price method was used to assess fish value. Among the other castes in the four villages surveyed, the Boksha (schedule tribe) community observed the maximum collection of fish. Of the total 182 households, 53 households were engaged in fish collection. The involvement of men was more in the process of collecting fish. Table 9 represents the information about the demographics of villagers involved in collection of fish and its quantity.

The assessment of fish catches in the Asan Conservation Area (ACR) was done by multiplying the fish consumption in the four villages by the average fish marketprice.The maximum amount of fish procurement of fish was witnessed at the time of dam closure during rainy seasons. The Total quantity of fish consumed and the average market rate of fish as per survey of four villages was 1042 Kg and 190 Rs/kg. Hence, the total cost of fish consumed was 197980 INR**.**

Table 9:Quantity of fish collection per year in Asan Conservation Reserve (ACR).

Village attributes	Kunja(n=44)	Dhalipur(n=60)	Matakmajri(n=39)	Kunja grant(n=39)	% HH involved
No. of Households	20	13	16	4	47
Male	24	13	22	6	23
Female	2	0	0	0	42
Fish harvested/ year (kg)	607	90	321	24	11

HH= Household

Tourism is another major ecosystem service provided by the lake and it is an important site for migratory bird. Many people are involved as shop owners, lodge operators, and boating activities. Number of tourists visiting the lake and their average expenditureprovide information on the revenues and income generated by wetland aesthetics. This represents the direct use of wetland. Garhwal MandalVikas Nigam (GMVN) Resort acts as a main tourist hub in Asan Conservation reserve. Primary data was collected from the GMVN Resort regarding the tourist stated there revealed data on income by lodge ownerfor the year 2018-2019. The total income generated by GMVN was 5011741 INR. Table 11 represents the direct values of tourism related activities.

Table 10: Direct value of Tourism related activities.

Activities	Valuation (INR)
Boating	1556406
Lodging	884940
Canteen	1677171
Entry fee	893224
Total	**5011741**

Local people also collect *Typhaelephantina* (Elephant Grass) as roofing material that is present abundantly in the Asan wetland. It is a perennial grass locally called as ‘patera’and grows nearby streams and lakes.Boksha community (Schedule Tribe) collect it and used for their stables and houses. The quantity of roofing materials wascalculated by a survey based on a questionnaire, and the rate being Rs 4/kg. An average bundle of freshly collected elephant grass estimated as 5 kg (approx.). It was estimated that the studied villages annually use 1275 bundles (or 6375 kg). The shelf life of elephant grass is 1 to 1.5 years. Thus a direct value of procurement of elephant grass was estimated as Rs. 25500.

The net value of biodiversity conservation was calculated using revealed price method. The study used the financial support provided by the government agencies i.e. Forest Department to conserve biodiversity for the estimation of biodiversity services. The total of 30000 INR was spent for the construction of mud houses in the wetland. It was considered as the indirect value for biodiversity conservation.

The Asan Reserve has become the first wetland of the Ramsar wetlands in Uttarakhand.The foregoingdetails clearly revealed that theAsanConservation Reserve (ACR) offered a wide range of goods and services to the local community. The total cost evaluated for Direct values of Forest and Wetland Ecosystem Services like fuel wood, fodder, bedding leaves, NTFP, Fish, Tourism, Elephant grass was 266,718,600 INR, 17,296,875 INR, 335000 INR, 1816 INR, 197980 INR**,** 5011741 INR, 25500 INR respectively. Indirect values of Forests and wetland Ecosystem services included soil Nutritional Value, and biodiversity conservation in wetlands. The total cost of soil nutrition and biodiversity conservation in wetlands was calculated as 115300.5 INR and 30000 INR Kunja, Kunja Grant and Matakmajriexhibited high dependence on resources. Dhalipurexhibited minimal dependence on forests and wetlands as the local inhabitants in this village are socioeconomically better than other villagers. Kunja and Matakmajri are adjacent and completely dependent on forests and wetlands, directly or indirectly. The inhabitants of Kunja and Matakmajri mainly use fodder, firewood and bedding in winter. The existence of liquefied petroleum gas reduces their dependence on forests for fuelwood. The government should provide incentives to improve the morale of the residents. Proper management of wetlands can be achieved by strengthening wetland tourism. This can increase people's motivation to protect wetlands. The creation of employment opportunities would contribute to the development of the town. Due to the great economic importance of these forest and wetland ecosystem services,

payment for ecosystem services (PES) should be the internal part of policy of Uttarakhand.With the exception of street vendors, cafeterias, etc., the local community has benefited less from tourism. Families depend on firewood, fodder, bedding leaves, and a small amount of forest products. The consumption of forest and wetland products by the Boksha community (Schedule tribe) should receive a great deal of attention. Lack of education and awareness can pose a serious threat to the protection of forests and wetlands. An adaptive management of the Asan wetland seems to be the best approach with an active participation of local communities. Also, there is a need to create more awareness related to ecosystem services being generated by the wetland and surrounding forest areas.

Enhancing capacity of technical and field

It is strongly realized that socioeconomic developmentand sustainable use of bioresources are of critical importance for any given region. Uninterrupted supply of ecosystem services should be ensured for all ecosystems. It needs anintegrated approach toconserve biodiversity and ecosystem services, and mainstream them in all development planning process at local, regional and national levels. For this, capacity development is highly demandingthat built skills, understanding, and technical capabilities of individual and institutes. Considering that Forest department is the main stakeholder in biodiversity conservation and maintaining ecosystem services, the capacity of its official need to be built as long-term effort. Considering this, a two days training programme on Mainstreaming of Ecosystem Services in Development Planning Process was organized on the importance and methodology of evaluation of Ecosystem Services at Dehradun (Rampur Mandi Training Centre, Chakrata Division, Dehradun, Uttarakhand) during 29-30 September, 2021 byUttarakhand Science Education and Research Centre (USERC) with the support of Forest department, and Department of Information and Science Technology, Government of Uttarakhand.A training manual on **evaluation of forest and wetland ecosystem services**was preparedin consultation with subject experts and Forest department officials that comprised major ecosystem type and their functions, details on ecosystem services, biodiversity, sustainable management of forest resources, best practices on watershed management, and valuation of ecosystem services. A total of 70 officials of Forest department representing 7 districts of the state participated in this training. and its mainstreaming in development planning process.

The trainers represented scientists and subject experts from USERC (including PI), officials from SridevSuman University**,** Uttarakhand Space Application Research Centre,Forest Research Institute, Graphic Era University, G.B. Pant National Institute of Himalayan Environment and Sustainable Development, and Forest department. Details of the training are provided in Box 1.

Box 1: Training on Mainstreaming of Ecosystem Services in Development Planning Process

Activity 1: ***Importance of Ecosystem Services***

- Structure, Functions and Types of Ecosystem**;** Introductionto EcosystemServices; Importance of Biodiversity; role of Ecosystem Services in sustainable management of forest; Best practices in Watershed Management

Activity 2: ***Mainstreaming of Ecosystem Services in Development Planning Processes***

- Role of foresters in the valuation of Ecosystem Services; Best Practices of Ground Water Recharge and management; **Methods of valuation of Ecosystem Services**; Sustainable Management of Forest Ecosystem Services

Activity 3: ***Upgrade skills on the application of economic valuation of ecosystem service***

At the end of the training a feedback was also taken from all the trainees. They informed that ecosystem degradation not only impacting resource availability but also reducing the supply of ecosystem services. Therefore assessing ecosystem services can provide a direct value to resources and its possible benefit in ecosystem health, and various other direct/indirect benefits. Efforts should be made to improve status of forest through plantation and other conservation efforts besides, pollution control, ban of polythene; prevention of water pollution, checking of deforestation, awareness campaigns is highly desirable.100% of trainees found the training useful,and 85% of trainees suggested to increase in number of days for such trainings. The participants revealed that resource governance is multi-dimensional therefore all departments, agencies, stakeholders, etc. should join hands to take benefit of such training. The officials also rated the programme components. Overall grading of the programme with reference to relevance of course, module/course content, benefits/usefulness of the training was 8 out of 10.

Role of ecosystem services in policy and management

The study identifies that there are an increasing worldwide effortsto incorporate ecosystem services value into public and private decisions. At present it is more commonly used in western countries and also integrated into governmental planning processes (USA, European Union, China, etc.). It is argued that highlighting the value and decline of the state or country's living capitalattract more attention to develop sustainable strategies for conservation and management (e.g. biodiversity, ecosystems, etc.). Many International bodies and initiatives(as taken up by Convention on Biological Diversity (CBD), Millennium Ecosystem Assessment, World Bank, The Economics of Ecosystems and Biodiversity (TEEB) project) use it as an important principle in all its activities and programmes. The initiatives on**Payments for ecosystem services (PES)**have been initiated in many countries thatincentivize the provision of ecosystem services by private suppliers, fast emerging worldwide, including national programs in many countries. However, despite of significant progress in such efforts, many areas of ecosystem services analysis and policy integration remain at a proof-of-concept stage

Suggestions Mainstreaming of Ecosystem services mainstreaming in policy planning

The study leads to some suggestion for mainstreaming ecosystem services in development planning process. It was found that considerable researches are available on ecosystem services (mainly from outside India). The major research focus is on biophysical and valuation assessments of services, and there is a need of more integration of social aspects. For safeguarding of ecosystem services and to ensure continued flow of services, the adaptive management need to be strengthened. There is a greater need of capacity building of institutions, officials and other stakeholders to empower them on the subject. There is definite benefit of incorporating ecosystem services knowledge into the policies and practices of each sector as it would lead a greater awareness on improving the status of country's natural capitaland devising sustainable conservation and management strategies.

PLATES

PLATE 1 Asan Wetland

PLATE 2 Questionnaire based survey

PLATE 3 Fuel Wood Collection

PLATE 4 Local marketing of Fuel wood

PLATE 5 Collection of green fodder

PLATE 6 Buds and Calyx of *Bombaxceiba*

PLATE 7 Roofing material by elephant grass

PLATE 8 Collection of Elephant grass

PLATE 9 Weighing the amount of Elephant grass

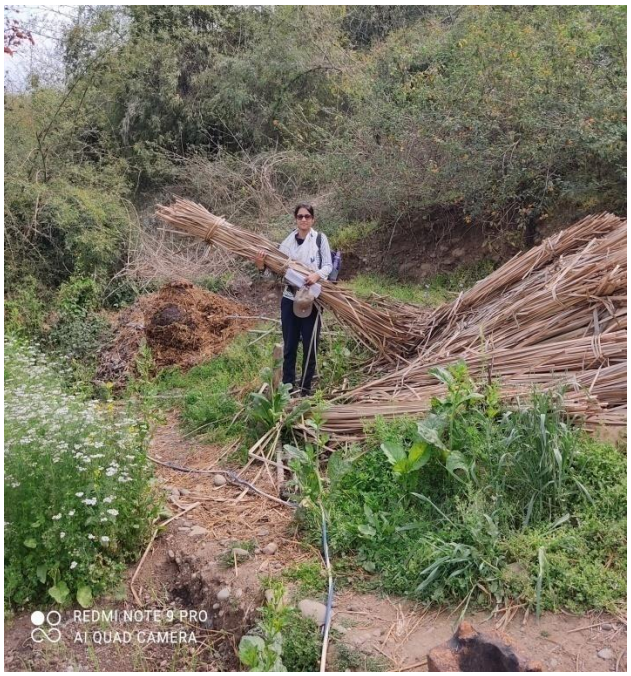

PLATE 10 Dry Elephant grass for roofing

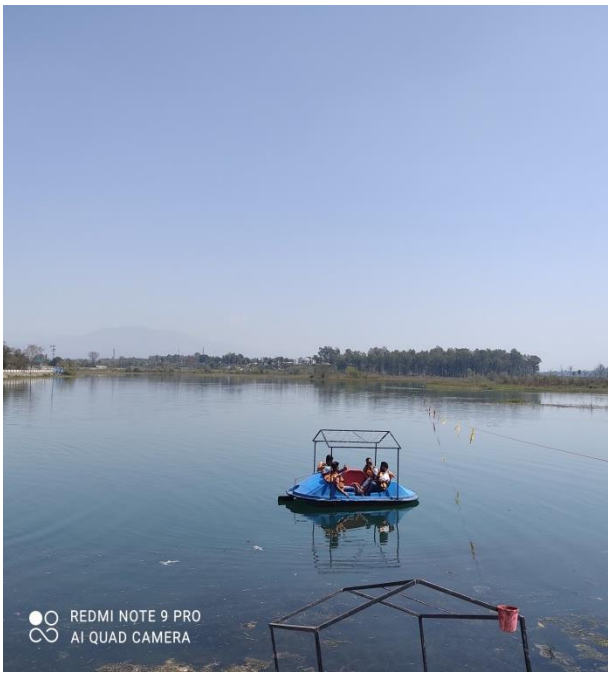

PLATE 11 Recreational activities in Wetland

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Registration Form

(Himalayan Researchers Consortium-2022)

Mode: **Online**

Dated: **October, 2022**

1. Name of Participant - **Dr. Manju Sundriyal (PI)**

2. Research Title: ECOSYSTEM SERVICES AND ITS MAINSTREAMING IN DEVELOPMENT PLANNING PROCESS

3. Position:… **Scientist**

4. Organization/Institute: **Uttarakhand Science Education and Research Centre (U-SERC)**

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6. Any other details:

Project is completed in May 2022. Presentation will be done by the PI of the project.

Place - Dehradun Date - 21.10.2022

Signature