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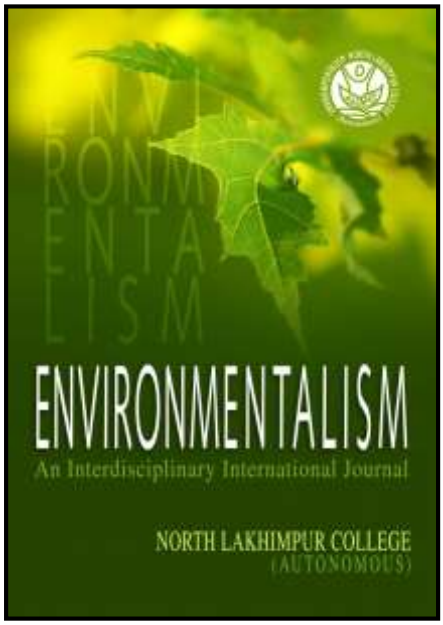

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ASSESSMENT OF PROVISIONING ECOSYSTEM SERVICES OF SATAJAN WETLAND AND BIRD SANCTUARY, LAKHIMPUR DISTRICT, ASSAM, INDIA

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Abstract

Wetlands provide important and diverse benefits to people around the world, contributing various ecosystem services. The assessment of provisioning and cultural ecosystem services provided by Satajan wetland of North Lakhimpur, Assam revealed that wetlands provide livelihood benefits to the local people especially the Mishing tribe as well as it provides various other services to the human being like irrigation water, enhancement of soil fertility, habitat provision to various aquatic animals and plants for which further study is suggested. For the valuation of the provisioning services in the wetland different pricing methods were used such as Market Cost Valuation method, Alternative Valuation method, etc. The evaluated value of the provisioning services of Satajan wetland and Bird sanctuary of Assam was recorded and evaluated which indicates that this wetland contributes several benefits to the villagers nearby and also to the people as a whole. Though, Provisioning Ecosystem services give more livelihood support than that of other Ecosystem services.

Keywords: Ecosystem service, wetland, bird sanctuary

1 Introduction

An Ecosystem is a natural community that is made up of all kinds of living organisms and non-living components, which include a network of interactions between organisms and their environment. However, they are linked up with human society and human welfare. Human civilizations have been aware of the benefits of the goods and services provided from the environment or nature, mainly food, fuel and fiber. Although, in the recent times, the value of services like climate control, water filtration, soil fertility, production of edible items as well as recreational and cultural services has become more apparent. Ecosystem Services are the various benefits or services that human being gain from the natural environment or the natural ecosystems like forest ecosystem, grassland ecosystem or aquatic ecosystem. Collectively, these services are known as "Ecosystem Services". Ecosystem services are the direct and indirect benefits that human society gets from the environment or an ecosystem (*Millennium Ecosystem Assessment framework,* MA 2000). Ecosystem services have four distinct categories:

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***1.1 Provisioning* services**

Provisioning services are ecosystem services that describe the material or energy outputs from ecosystem. Provisioning ecosystem services include products obtained from ecosystems, such as food, water, timber, fibers, or genetic resources.

1.2 Regulating services

Regulating services are the services that ecosystem provides by acting as regulators. It includes air quality regulation, climate regulation, water purification, disease regulation, pest regulation, pollination and natural hazard regulation, where some of these services e.g. pest regulation, seed dispersal, disease regulation and erosion regulation, have been artificially supplied and counted as costs of production. Other services, such as climate control, have been outside the market but are now being priced and integrated into markets; the most notable is carbon sequestration.

1.3 Supporting services

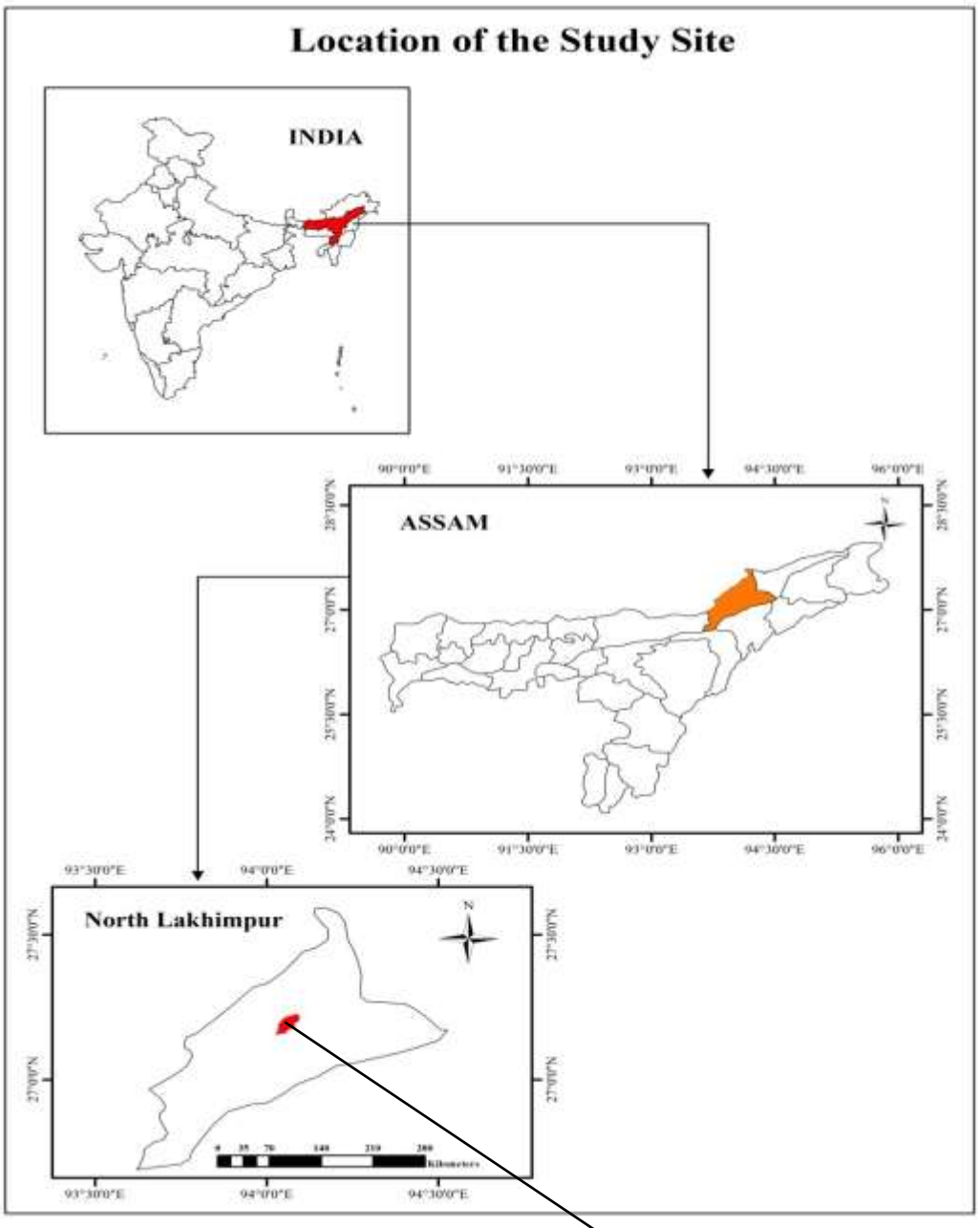
Supporting ecosystem services are the services which includes the basic ecosystem processes of nutrient cycling and primary productivity that may, in turn, lead to the other services, of which most have traditionally been unvalued, although their importance has been acknowledged through government investment in soil and biodiversity conservation. Others, such as water for environmental flows, are the subject of emerging markets.

1.4 Cultural services

Cultural ecosystem services include benefits that people obtain from ecosystems related to spiritual enrichment, recreation, ecotourism, aesthetics, formal and informal education, inspiration, and cultural Heritage, this services include knowledge of country and place, which is important to Indigenous people. Another example is nature based tourism that has significant economic value. However, many cultural services have not been explicitly priced or included in markets.

Wetlands are among the most valuable ecosystem on the globe. It provides the most valuable benefits to human mankind. These are the area or lands that are either permanently or temporarily covered with water. Wetlands exhibits the diverse form of life starting from molecular level to big animals according to their geographical location, climatic condition, and soil / water quality. Although the value of wetlands for fish and wildlife protection has been known for a century, some of the other benefits have been identified more recently. Wetlands are sometime described as kidneys of the landscape because they function as the downstream receivers of water and waste from both natural and human sources. They stabilize water supplies, thus mitigating both floods and drought. They have been found to cleanse polluted waters, protect shorelines, and research ground water aquifers. Wetland also has been called nature‘s super market because of the extensive food chain and rich biodiversity that they support. They play major roles in the landscape by providing unique habitats for a wide variety of flora and fauna. Now that we have become concern about the health of our entire planet, wetlands are being described by some as important carbon sinks and climate stabilizers on a global scale. India has a wealth of wetland habitats of immense ecological importance and exhibit enormous diversity based on origin, geography, hydrological regime and substrate types. However, wetlands provide us the benefits that help us in balancing and maintaining the natural habitat which is interrelated to the human society. Wetland Ecosystems are part of our natural wealth. The amount of benefit provided by wetland ecosystem (globally) is very high. Some of the benefits people obtained from ecosystem, provided by wetlands are:- Flood control, Groundwater replenishment, shoreline stabilization and storm protection, sediment and nutrient retention and export, water purification, reservoirs of biodiversity, wetland products like fish and NTFP, cultural value, recreational and tourism, climate change mitigation and adaptation, etc.

2 Study Area



Satajan Wetland and Bird Sanctuary, North Lakhimpur, Assam

2.1 Satajan Wetland and Bird Sanctuary

The present study is carried out in Satajan Wetland and Bird Sanctuary, North Lakhimpur, Assam. The geographical location of the Satajan wetland is 27°12'36''N and 94°2'56''E at an altitude of 101m above mean sea level. The satajan is located in the floodplain of Ranganadi river regulated by 405 MW Ranganadi Hydroelectric Project which

was created by devastating earthquake of 1950. The area received an average annual rainfall of 2949 mm, which occurred during the monsoon. Climate of the area is monsoonal tropical with summer temperature of 35-38°C and 6-8°C during winter.

The case we were going to study is all about the Satajan Wetland (Beel), Lakhimpur district, Assam. Lakhimpur is an Administrative district of Assam that lies on the North bank of the river Brahmaputra. The district is multi-cultured and multi ethnic in nature where majority are Assamese peoples. Other than Assamese peoples, Mishing tribe, Bodo tribe, Deori, Tiwa live together with a unity showing a big cultural and traditional bonding. Satajan is a unique habitat of aquatic flora and fauna, which lies in the Eastern part of the district. The area of wetland is about total 95 acre (as consulted from Wetland sector office, Forest branch, Lakhimpur, Assam). It has been investigated that, besides three species of endangered turtles, as many as 34 species of residential and 13 species of long distance/migratory birds and more than 25 species of fish fauna in satajan is recorded (Green Heritage, Assam 2007-08) Satajan wetland provides the services that are very beneficial for human mankind and their livelihood (food, fuel, fiber, fodder, fertile soil, recreation and other cultural aspects). The Satajan Wetland and bird sanctuary is surrounded by three small villages of Mishing tribe. The Mishing peoples have the spiritual believe about the Satajan wetland and River Ranganadi, where every year, during rainy season they celebrate "Kanipan" (a traditional festival of Mishing tribe) for the good health of river Ranganadi and Satajan wetland. The Mishing peoples near satajan wetland gain direct benefits from the wetland area. They directly depend on satajan for their survival and their livelihood. They collect their day to day needs like firewood, wild edible plants, medicinal plants, fishes, fodder, etc for their livelihood purposes. Satajan wetland and bird sanctuary plays an important role in providing beneficial services to the local peoples and other visitors. But day by day the services that Satajan wetland provide to the local peoples was decreasing due to human made disasters and also due to some environmental factors like climate change, etc.

3 Methods and Materials

3.1 Data Collection

Data is collected through surveys. Three types of surveys were conducted for the present study.

(i) **Key information interview**, (ii) **Focus group discussion** and (iii) **Household surveys.**

In all the three categories, we involve direct analyzed and qualitative questionnaires and other techniques by using the local language (Assamese and Mishing).

First, we have focused on **Key information interview** where we visited the local communities and Divisional Forest Officer (DFO), Forest and Wetland sector, Lakhimpur, Assam and Forest Ranger Officer, Lakhimpur, Assam, who have specialized knowledge on the use of the resources and their protection in Satajan wetland. **Focus group discussion** involves a group of 20 to 30 peoples from the village community. Majority were women. Here, we have discussed about various resource harvesting activities like fishing and hunting. It also includes

information regarding seasons, market and prices and about other economic values in order to assist with the survey design. **Household surveys** were used to collect quantitative data on natural resource use and other household activities. Here, we have discussed about various issues like household composition, location and employment status, obtain details on each of the resources harvested, the equipment used, the amount gained annually, the quantity sold as raw product and the selling price per unit, the number of products produced from natural products and the amount sold and selling price of those products.

3.2 Valuation Methods

3.2.1 Provisioning Services

For the valuation of the provisioning services in the wetland different pricing methods were used which are as follows:

3.2.2 Market Cost Valuation method (Ninan et al. 2015)

Most of the provisioning ecosystem services were evaluated by **Market Cost Valuation method**. This method is commonly applied to the measurement of both direct and indirect uses values of natural system, and can similarly be applied to the valuation of wetland areas. Market valuation uses standard economic methods to value goods or services that are bought and sold in market place. To estimate the provisioning services of the wetland 30 households near Satajan were visited and average value of the wild edible plant, fodder, firewood, fishes was calculated. From the average value the cost per year was calculated by Market Cost Valuation method.

3.2.3 Alternate Valuation Method (Ninan et al. 2015)

Here the Provisioning services were evaluated by opportunity cost of time spent for collecting the medicinal plants. Here, we use the **Alternate Valuation Method** to estimate the provisioning services of medicinal plants of the wetland, thirty (30) households were visited and an average value of medicinal plants extracted from the wetland was calculated. From the average value the total cost per year was calculated.

4 Results

4.1 Provisioning services

Table 1: Wild Vegetables / Wild edible plants by using **Market Valuation Method**

Sl. No.	Local Name	Scientific name	No. of households in Satajan	Quantity extracted from Satajan/household/day	Bundle/ Market cost	Value in Rupees (yearly)	Value in US$ (yearly)

01	Kosu (asm)	*Alocasia cuminata*	30	2 bundles	10	2,16,000	3,223
02	Tora (asm)	*Alpinia alughus*	30	3 bundles	10	3,24,000	4,837
03	Khutora (asm)	*Amaranthus spinosus*	30	4 bundles	05	2,16,000	3,223
04	Bonposola (asm)	*Meliosma pinnata*	30	2 bundles	08	1,72,800	2,579
05	Mejenga (asm)	*Zanthoxylam oxyphyllum*	30	2 bundles	10	2,16,000	3,223
06	Dhekia (asm)	*Diplazium esculentum*	30	2 bundles	15	3,24,000	4,835
07	Dimoru (asm)	*Ficus glomerata*	30	1 bundles	05	54,000	805
Total						Rs. 15,22,800	22,728

Table 2: Estimating value of Fodder (Grass) by using **Market Valuation Method**

Total bundles of grass used/ day/ household from the wetland	Total bundles of grass used/month/household from the wetland	Total household	Market cost/bundle	Value in Rs (yearly)	Value in US$ (yearly)
2	20 (Approx)	30	15	10,8000	1,612

Table 3: Estimating value of Fishes by using **Market Valuation Method**

Sl. No.	Local Name	Scientific Name	No. of household in Satajan	Quantity collected from the wetland/household/month (AVR)	Per Kg market cost	Value in Rs (yearly)	Value in US$ (yearly)
01	Kuhi	*Lebeo gonius*	30	3 kg	300	3,24,000	4835
02	Bhango	*Lebeo boga*	30	2 kg	250	1,80,000	2686

	n						
03	Rou	*Lebeo rohita*	30	4 kg	230	3,31,200	4943
04	Puthi	*Puntinus sophore*	30	5 kg	80	1,44,000	2149
05	Goroi	*Channa punctatus*	30	5 kg	120	2,16,000	3223
06	chengeli	*Channa gachua*	30	3 kg	60	64,800	967
07	Tora (spiny eel)	*Mastacembelus puncalus*	30	2 kg	120	86,400	1289
08	Kawoi	*Anabus testudineous*	30	3 kg	80	86,400	1289
09	Kuchia (Asian swamp eel)	*Monopterus albus*	30	7 kg	200	5,04,000	7522
10	Kholiho na	*Colisa fasciatus*	30	6 kg	50	1,08,000	1611
Total						20,44,800	30,519

Table 4: Estimating value of Firewood by using **Market Valuation Method**

Total bundles of firewood used/ day/ household from the wetland	Total bundles of firewood used/month/household from the wetland	Total household	Market cost/bundle	Value in Rupees (yearly)	Value in US$ (yearly)
3	10	30	5	5,40,000	8059

Table 5: Medicinal plants by using **Alternate Valuation Method**

Sl. No.	Local Name	Scientific name	Uses	NO. of total Household	Values in Rupees (Approx/yearly)	Values in US$ (Approx/yearly)
01	Bor manimuni	*Centella asiatica (Linn.)*	Leaves, as brain tonic, dysentery	30	36,000	537
02	Man dhonia	*Eryngium foetidum(Linn.)*	Leaves, headache	30	36,000	537
03	Mosondori	*Houttuynia cordata(thumb.)*	Leaves, chronic dysentery, stomach problem	30	60,000	895
04	Durun bon	*Leucas aspera*	Leaves, sinusitis problem	30	60,000	895
05	Tengesi sak	*Oxalis corniculata(Linn.)*	Leaves,diarrhoea	30	54,000	805
06	Dubori bon	*Cynodon dactylon(Pers.)*	Plant paste, stop bleeding from cut and injuries	30	60,000	895
07	Kola kochu	*Colacasia esculenta(Schoot)*	Petiole juice in cut and wounds	30	72,000	1074
08	Brahmi	*Bacopa monnieri*	Leaf juice as memory booster	30	96,000	1432
09	citronella	*Cynodon flexuosus*	Leaves juice in diff kinds of skin disease	30	48,000	716
10	Noyontora	*Catharanthus roseus(Linn.)*	Flower paste used in insect bites	30	42,000	626
Total					5,64,000	8417

Table 6: Fresh water by using **Alternate Valuation Method**

Total liters of fresh water used/ day/ household from the wetland	Total liters of fresh water/month/house hold from the wetland	Total household	Municipality cost /bill/month	Value in Rupees (per year)	Value in US$ (per year)
100	3000	30	150	54,000	805

Table 7: Total Value of provisioning services

Sl. No.	**Services**	**Method of valuation**	**Value in INR**	**Value in USD**	**References**
01	Wild edible plant	Market cost valuation method	15,22,800	22,728	Self study
02	Fodder		5,40,000	8059	Self study
03	Firewood		5,40,000	8059	Self study
04	Fishes		20,44,800	30,519	Self study
05	Fresh water	Alternate cost valuation Method	54,000	805	Self study
06	Wild Medicinal plants		5,64,000	8417	Self study
Total			52,65,600	78,591	

5 Discussion

5.1 Wild Vegetables / Wild edible plants by using Market Valuation Method

Satajan village is inhabited by Mishing and Assamese people. Most of them are isolated wetland dwellers. They are directly or indirectly dependent on the wetland for various services that the wetland provides. We have surveyed 30 households. The villagers collect wild edible plants for self consumption and also for sale to earn money. After the valuation, we came to know that the villagers of satajan benefit from the collection of wild edible plants from the wetland and the net gain is approximately is 15, 22,800 INR (approx) or 22,728$ (approx) per year (Table-1). From these result, we can directly say that the villagers were profited from the Satajan wetland by using those wild edible plants.

5.2 Estimating value of Fodder (Grass) by using Market Valuation Method

The villagers collect fodder that the wetland to feed their cattle's. Since, fodder grass is a seasonal product it is mainly collected during the rainy season. The valuation of the fodder grasses was done by using Market valuation Method (Table-2). Average income generated from the fodder is evaluated by quantifying the amount of grasses extracted per household in one year. The value obtained after multiplying is further multiplied with the total household of Satajan.

5.3 Estimating value of Fishes by using Market Valuation Method

Varity of fishes like *Puntinus sophore, Channa punctatus etc* were collected from the wetlands for self consumption as well as for sale from the wetland which on average valuation gives an amount of Rs. 20, 44,800 INR (approx) or 30,519$ approx. Table-3). Fishing provides livelihood to the villagers as this is the only resources which are available all throughout the year.Among the all Provisioning services of Satajan wetland, fishes have the high percentage of market value then other provisioning services.

5.4 Estimating value of Firewood by using Market Valuation Method

Firewood collected from Satajan wetland and bird sanctuary area were used for self utilization of their household needs by the villagers. An amount of Rs. 5, 40,000 INR (approx) or 8059$ (approx) on average is provided from the firewood (Table-4).

5.5 Medicinal plants by using Alternate Valuation Method

The Mishing tribe has rich traditional knowledge of using various plants as medicine which they generally collected from the Satajan wetland like *Centella asiatica, Bacopa monnieri, Cynodon dactylon, etc.* Valuation of the medicinal plants was done through Alternate Cost Valuation method and total cost evaluated was approximately Rs. 5,64,000 or $ 8417 (Table-5).

5.6 Fresh water by using Alternate Valuation Method

Dissolved oxygen (DO) and pH of water from the wetland indicates good water quality where different life forms can be supported. The local community depends on satajan wetland for fresh water for their various purposes like drinking, bathing, and irrigation etc. After comparing the daily water usage and cost of municipality water supply in Lakhimpur town area we conclude that the wetland provide an alternative source of water for the villagers whose value is approximately 54,000 INR (approx) or 805$ approx. (Table-6).

5.7 Total Value of provisioning services

Table 7 shows the evaluated cost of different provisioning services provided by the Satajan wetland of Lakhimpur district, Assam. After assessing the total value of all the services, it is found that among the resources provided by the wetland fishes provides the highest value while fresh water for consumption and local usage provides lowest value (Rs. 54,000 or $ 805).

6 Conclusion

The assessment of provisioning ecosystem services provided by Satajan wetland of North Lakhimpur, Assam revealed that wetlands provide livelihood support to the local people especially the Mishing tribe as well as it provides various other services to the local community like irrigation water, enhancement of soil fertility, habitat provision to various aquatic animals and plants for which further study is suggested. The evaluated value of the provisioning services of Satajan wetland and Bird sanctuary of Assam was Rs 52, 65,600 or $ 78,591 which indicates that this wetland provides several benefits to the villagers nearby and also to the people as a whole. Satajan wetland also provides aesthetic value due to the periodic migration of local and migratory birds. From the present study, we can conclude that the local communities (tribes) residing near the Satajan wetland is directly or indirectly benefited by the wetland.

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