Volume 16 Issue 11
Originally issued as C1

Global Journal of Science Frontier Research: C
Biological Science
Volume 16 Issue 1 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Contribution of Three Sedges of *Cyperus* in the Rural Economy of Sundarbans, India

By Sumit Manna, Sudipta Mukherjee & Anirban Roy
West Bengal Biodiversity Board, India

Abstract- Three sedges of *Cyperus* (*C. malaccensis, C. compressus* and *C. iria*) are used for making mats by the forest fringe people of Sunderban mangrove swamp and sale in local markets. The focus of the work is to calculate species wise net economic contribution of these sedges. Fifteen families from each four villages of two islands have been selected for qualitative and quantitative assessment of these resource use pattern through participatory observation and questionnaire method. The annual production, economic valuation of individual species were assessed through quadrat sampling (272 habitat patch) and market survey with cost benefit analysis respectively. Economic contribution of the sedges to the local people in terms of annual income is highest in case of *C. malaccensis (6.638%)* followed by *C. compressus* (1.599%) and *C. iria* (0.690%). The production of the three species is 5-8 times higher than paddy, thus have potentiality as alternative livelihood options.

Keywords: bioresource, rural economy, sedges, sundarbans, value chain.

GJSFR-C Classification : FOR Code: 069999

Strictly as per the compliance and regulations of :

© 2016. Sumit Manna, Sudipta Mukherjee & Anirban Roy. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Contribution of Three Sedges of *Cyperus* in the Rural Economy of Sundarbans, India

Sumit Manna [α], Sudipta Mukherjee [σ] & Anirban Roy [ρ]

Abstract- Three sedges of *Cyperus* (*C. malaccensis, C. compressus* and *C. iria*) are used for making mats by the forest fringe people of Sunderban mangrove swamp and sale in local markets. The focus of the work is to calculate species wise net economic contribution of these sedges. Fifteen families from each four villages of two islands have been selected for qualitative and quantitative assessment of these resource use pattern through participatory observation and questionnaire method. The annual production, economic valuation of individual species were assessed through quadrat sampling (272 habitat patch) and market survey with cost benefit analysis respectively. Economic contribution of the sedges to the local people in terms of annual income is highest in case of *C. malaccensis (6.638%)* followed by *C. compressus* (1.599%) and *C. iria* (0.690%). The production of the three species is 5-8 times higher than paddy, thus have potentiality as alternative livelihood options.

Keywords: bioresource, rural economy, sedges, sundarbans, value chain.

I. Introduction

Sundarbans, the world's largest mangrove ecosystem with highest number of mangrove plant species, nurtures significant bioresources that are encouraging to local inhabitants for subsistence use as well as income generation since a long back. This unique estuarine deltaic settings makes possible for co-existence of both immense biodiversity and human settlement and thus as a source of daily household needs to the 4 million aboriginal people (one of the poorer section of India) inhabiting in forest fringes. As 56% people of that area are landless, so they are to depend on the wild floristic resources as food, fodder, medicines, fuel, and house building materials for their daily life support (Singh et al. 2010).

Globally around 500 million people directly and one billion people indirectly depend on wild floristic resources (WFRs) (Alexander et al. 2002). Forest fringe people of Africa get their food, fuel, medicine, constructive materials and fodders through collecting wild floristic resources (Byron & Arnold 1999). According to them about 10% of the rural people of Ghana harvest WFRs for their cash income. About 85% household products of the rural people of South Africa are generated from WFRs (Charlie & Sheona 2004). An estimation of US$ 6,800 per hectare from WFRs of Amazonian rain forest which was far higher than the returns from timber harvesting for subsequent plantation or cattle ranching (Peters et al. 1989). Mahapatra & Tewari (2005) estimated that the net present value of revenues from Non-Timber Forest Products (NTFPs) were more as compared to potential timber revenue. Though southern Asia has a long history of human use of forest product (Bawa & Godoy, 1993), the importance of WFRs for rural forest based populations was seldom considered significantly for a long period. A useful & growing body of literature has been established that deals with forest environment valuation including many of the non-market values that were omitted from the calculation in past. But all these literature dealt with NTFPs as a whole or categorized it as food, fodder, medicine, oil yielding plant and very often sub categorized species level contribution to the household level. Manna & Roy, (2013) made an estimation of about Rs. 2068.07 was contributed by wild edible mushrooms to a Santal (Tribal) family per year in the Eastern lateritic part of India which was 10.06% of the total annual income of a tribal family.

The mangrove forest of Sundarbans is valuable as it is a treasure house of rich biodiversity which are commercially exploited, particularly WFRs, which is one of the epitomes for many forest fringe dwellers (Bhattacharya, 2004). The NTFPs of that area such as tannin bark (like *Ceriops decandra, Ceriops tagel, Phoenix paludosa* yield around 30-32% tannin), thatching materials (*Nypa fruticans*), natural honey (*Apis dorsata*), fuel woods, small poles and boles, fish, prawn and crabs attract locals for subsistence or commercial use. An estimation of 79% on an average to the annual income of harvesters' family was generated from these bioresources in Sundarban areas (Singh et al, 2010). Apart from that, many studies related to ecology and taxonomy was performed by many authors (Banerjee 1964; Das 1981; Naskar and GuhaBakshi 1982; Chakrabarti 1986; Mondal and Ghosh 1989; Chaudhuri and Chowdhury 1994; Chattopadhyay 2003, Manna et al. 2012). But the production, utilization and family wise contribution of WFRs of that globally significant geographical terrain was seldom accounted.

Today, sedges are used throughout the tropics for basketry and handcraft weaving, and in parts of Africa and Asia these are cultivated for such purposes. These are also used for thatching, fencing, rope making,

Author α σ ρ: West Bengal Biodiversity Board, Department of Environment, Government of West Bengal, FD415A, Sector- III, Salt Lake City, Kolkata, West Bengal. e-mail: aroy.wbbb@gmail.com

© 2016 Global Journals Inc. (US)

and perfumery. Several species are recorded as having medicinal properties while others have the potential for use in erosion control and sand stabilization. Local backward aboriginal people of Sundarbans traditionally used three species of Cyperaceae- *Cyperus malaccensis* Lam., *Cyperus compressus* L. and *Cyperus iria* L. for preparation of mat which are either sold in the local markets or used for household purposes. Present study was under taken to highlight the actual and potential annual production, present utilization and contribution per capita of three species of Cyperaceae, widely utilized by the local inhabitants in preparation of ethnic mats in that area, using different models for their value chain analysis. A comparative analysis of the contribution of rice (O. *sativa*, widely accepted and used as a cash crop) and these three species of Cyperus were also made in the present study.

II. Materials and Methods

a) Study area

The Sundarbans (Extends between 21°32" North and 22°40" North Latitude and between 88°05" East and 89°00" East Longitude) forest lies in the vast delta on the Bay of Bengal formed by the super confluence of the Padma, Brahmaputra and Meghna rivers across southern Bangladesh. The Indian part of sundarban is demarcated by the river Hooghly on the west, the Bay of Bengal on the south, the Ichamati-Kalindi-Raimongal rivers on the east and the Dampier-Hodges line on the north. The forest covers 10,000 sq. km of which about 4,200 sq. km is in the South 24 Parganas district of West Bengal, India. The forest became a UNESCO world heritage site in 1987. Out of total 4,200 sq. km about 1,700 Sq. km is occupied by water bodies in the forms of river, canals, creeks and ponds of width varying from a few meters to several kilometers. This Indian land mass is bound on the west by river Muriganga and on the east by rivers Harinbhagha and Raimangal. Other major rivers flowing through this eco-system are Saptamukhi, Thakurain Matla and Gosaba. A land of 54 tiny islands, criss-crossed by innumerable tributaries of the Ganges is now the abode of varied floral & faunal population. The inhabitants of the fringes of Sundarbans are prohibited from entering the core region and need permission for collection of NTFPs from buffer region. The annual temperature of that area ranges from 20°C to 42°C in summer and 9℃ to 32°C in Winter and average annual precipitation of South 24 Parganas stands at 1876.3 mm with total rain days of 81.8 (Alipore Meteorological Department, Kolkata, 2009).

For the present study Gosaba (22°14'32.1" N to 22°06'27.5" N and 88°52'06" E to 88°46'22.0" E) & Sadhupur (22°10'12.5" N to 22°05'08.3" N and 88°55'28.0" E to 88°49'25.5" E) islands of Sundarban were selected on the basis of their dense human settlements. Most of these local communities have little or no land of their own which compelled them to depend on Wild Floristic Resources (WFRs). Average annual income of each of the family with minimum available land of these two islands is Rs. 36,000.00 (SD. Rs. 4,500.00) of which maximum portion comes from working as a daily labourer in agricultural fields in pre-monsoon and post-monsoon seasons. Some people from Below Poverty Level (BPL) families also work on daily wage basis in different government employment schemes. Of a total of 222,822 people living in Gosaba, 143,221 people (64.28%) belongs to scheduled caste (SC) community where as 6992 people living in Sadhupur, 5756 people are under SC community (Census, 2011). Agriculture is the main livelihood option for the people those who have little or adequate land for farming. Those who are landless or little land holders generate their economy through "100 days work" under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), or they work as daily labourer in agricultural field. From these different livelihood options they get their food security for 7-8 months, but for the rest of the year they have to depend on the WFRs.

b) Methods

Two villages from each of the two islands (viz. Pakhirala and Dulki from Gosaba island; Hamilton Abad and Sadhupur from Sadhupur island) were selected randomly and from each of the village fifteen families (total 15×4=60 families in two islands) involved in mat making for generation of partial economy were surveyed. Information like local name of the species used as raw material for preparation of mattress, collection areas, season of harvesting (annual or biannual), amount of collection by the family in a season, used plant part etc. were collected through the group discussions (Goss 1996) which were arranged twice (December and January of 2014-2015 and July and August, of the year 2015) in all villages with backward communities mostly of scheduled caste, scattered in the study area. In each village 15-20 persons were involved of which more or less 70% were female, the principal collectors of sedges Cyperus and mat makers as well.

Dry weight of mat, made from different species were noted down along with the height and breadth. Information related to number of mats prepared from a particular species in a year, number of family members needed to be involved in making of the mat, presence of any value added service, intermediate market supplier (if any) and in case of direct selling to the market, distance of the market from the village and mode of transport were also collected through participatory observation (Marshall & Rossman 1999) and previously made questionnaires method (Grix 2004). A questionnaire was developed (local language translated into English into Table 1) and distributed among the villagers of each

© 2016 Global Journals Inc. (US)

village (25-30 sedge collectors). Seventy to seventy five percent duly filled questionnaires were returned back based on which the analyses were made. The data are used for cost benefit analysis of these species. The participatory observation was performed during the harvesting, mat making procedure in different villages of the study sites.

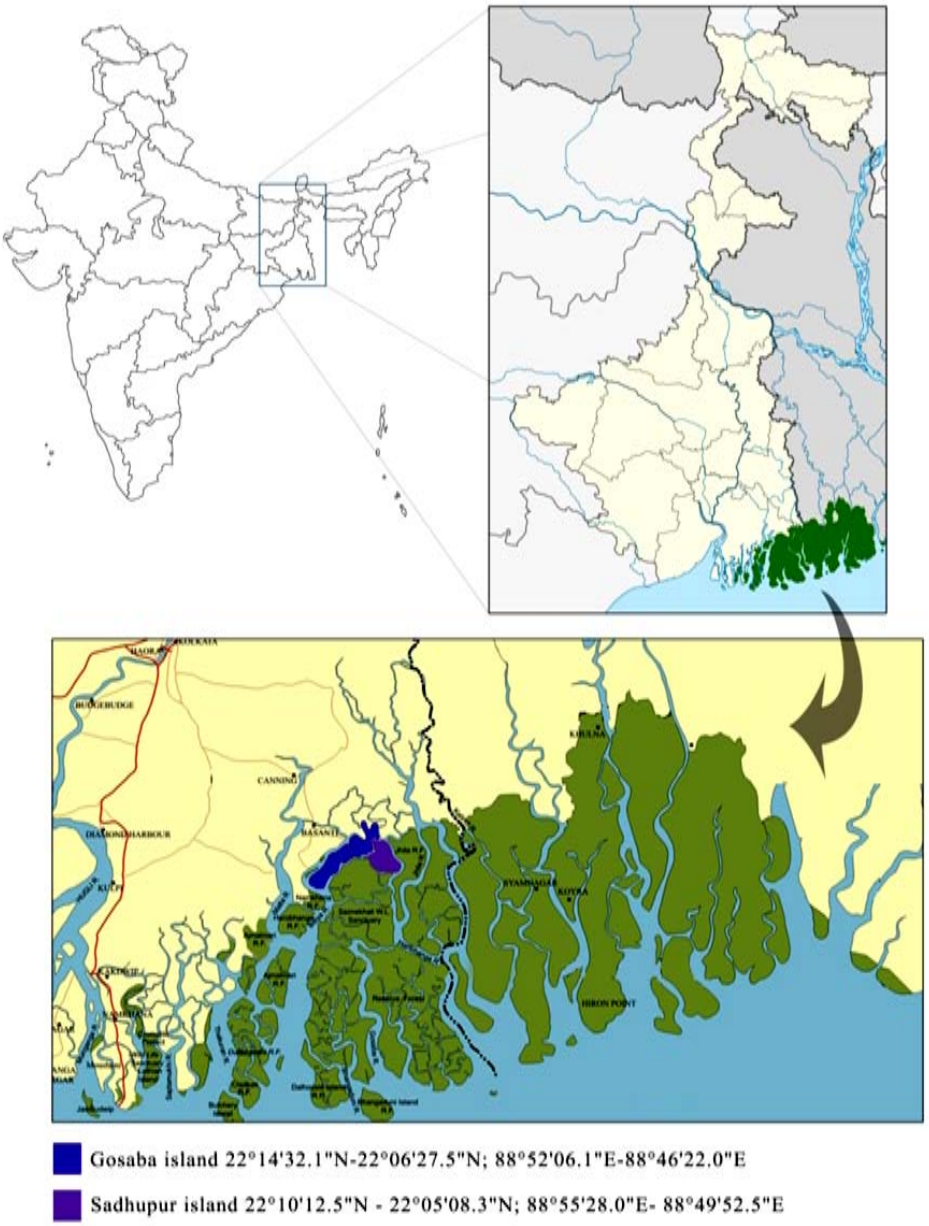

Fig 1 : Map of Study area

Table 1 : Questionnaire distributed among villagers (Translated in English)

Name:.....
Village: .....
Sex: .....
Age: .....
Any comment:.....
.....

© 2016 Global Journals Inc. (US)

Sl. No.	Vernacular name of the species used in mat preparation	Name of the species*	No. of mat prepared from a particular species in a year	Dry wt. of mat	No. of family members involved	Total man hour involved

** To be filled after identification of species*

Value added service (In Rupees)	Intermediate market supplier			In case of direct selling	
	Supplier 1	Supplier 2	Supplier 3	Distance of market from village (km)	Transportation cost (Rs/Q.)

To quantify the annual production of these three species, 272 ponds were visited randomly (136 from each island) and the geographical locations were taken using GPS (Garmin eTrex Vista). Annual production of each species was measured using quadrat {with quadrat size of (0.91 m X 0.91m = 0.83 sq. m)} in the places where the species were found to be growing. From each occurring site, eight quadrats were plotted. Wet biomass of the studied species of each of these sample units (quadrats) were weighed in the field separately, brought to the laboratory, transferred to the hot air oven (for 5 days at 75°C) and dry weight were measured. All the ponds without any direct inundation and having the salinity ranges between 2 ppt to 3.5 ppt were considered the potential habitat of these three species, as these species were not found to occur at higher salinity level (>3.5 ppt). The total potential habitats (bank area of the pond) out of these 136 ponds were measured directly in the field. Out of these 136 ponds, only the pond banks were selected as the actual habitat where these three species were found to be growing. From these, total actual habitat out of these 136 pond bank area were measured from where total actual habitat area of each species in every island was estimated.

c) Valuation of mats

Most of mats prepared from the species of Cyperaceae were used either directly as their house hold use or were sold (by the dwellers) to some local markets. Firstly during the year 2014 to 2015 all of the 3 species were tracked to know their ultimate level of transfer and their form of transfer (either in the form of mat or raw materials of mat) to the consumers from the local collectors to get the highest market price. Different value chain models were used for these species based on their level of transfer to the hand of consumers (diagrammatically represented in the Figure 2). Highest price of a species was considered as the present value of these species.

d) Assessing local markets

To calculate the economic worth of these *Cyperus* species in terms of money, three local markets (Haats), namely *Budhbaarer bazaar, Sukrabaarer bazar* were identified where the maximum portion of these bioresources were brought by the local community to sell from the forest fringe villages. Regular surveys of these local Haats/markets were carried out and the price of the mats were noted. Different value-monitoring factors, e.g., distance of these local markets from the villages, mode of transport of mats, and the number of intermediate market suppliers, if any, were considered for the cost-benefit analysis (Gowdy, 2007). While conducting the market surveys, the products were weighed intermittently to confirm the price per unit weight (kg).

III. Results

a) Actual and potential Production of These three species of Cyperus

A total of three species of *Cyperus* were found to be used in preparation of mat by 200 families of Sadhupur island and 150 families of Gosaba island of Sundarbans. All of these three species were found to be collected from wild. Recently *Cyperus malaccensis* had drawn quite attention by the villagers and sown for a

© 2016 Global Journals Inc. (US)

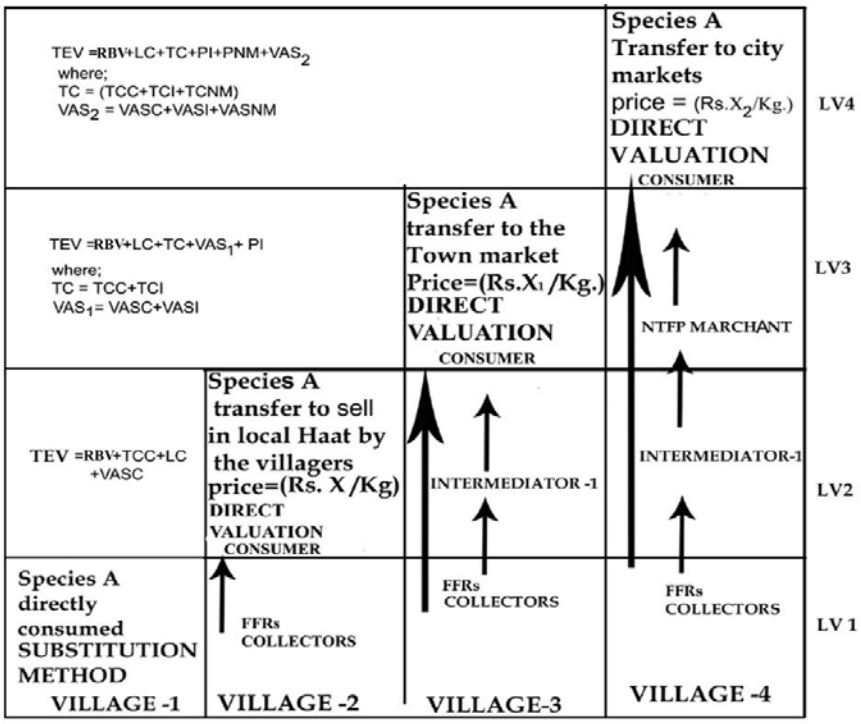

Fig 2 : Value of forest floristic resources (FFRs) always- LV1<LV2<LV3<LV4 or $x_2 > x_1 >$ x LV: level; TEV: Total Economic Value; RBV: Raw Bioresource Value; LC: Labour Cost (The labour used in collection of the resource together with the processing, transport and sale); TCC: Transport Cost of Collector; VASC: Value Added Services by Collector; VAS_1: Value Added services in level 3; PI: Profit of Intermediator-1; VASI: Value Added services of Intermediator-1; TEV_1: Total Economic Value in level 3; TCI: Transport Cost of Intermediator-1: PNM: Profit of NTFPs Merchant; VAS_2: Value Added services in level 4; TCNM: Transport Cost of NTFP Merchant; VASNM: Value Added services by NTFPs Merchant; TEV_2: Total Economic Value in level 4

single time on their pond sides for its superior quality and higher market value of the mats prepared from this species. They collected these species at least twice a year and needed not to be sown after their first plantation. Whereas, other two species (*Cyperus compressus* and *Cyperus iria*) were found to be collected from the side of canal, large water bodies and waterlogged areas. The study revealed that out of the total actual habitat for these three species of *Cyperus*, *Cyperus malaccensis*, *Cyperus compressus*, *Cyperus iria* covered 16622.39 SD. 1933.09 Sq. m, covered 5369.84 SD. 624.12 Sq. m, 10200.73 SD. 1186.09 Sq. m respectively which were 51.63%, 16.68% and 31.68% of their total observed actual habitat. As these species were mostly growing at a salinity range between 2 ppt to 3.5 ppt, the total potential areas of these three species out of 5262 pond bank areas was 1804549.2, 58291.46 and 110733.5 Sq. m. respectively. It was calculated that the total actual production of *Cyperus malaccensis*, *Cyperus compressus* and *Cyperus iria* were 161.90 Q., 84.68 Q. and 100.47 Q whereas on the basis of their potential habitat, these species might contribute their above ground biomass up to 1757.67 Q., 919.25 Q. and 1090.72 Q. respectively **(Table 2).**

Table 2 : Production of mat sticks. (May be inserted after 1st paragraph of Results)

Sp.	Total actual habitat in these two island (m^2)	Coverage of the total actual areas (%)	Total potential Habitat (m^2)	Actual Gross Production (Kg/Sq. m)		Actual Gross Production (Q.)		Potential Gross Production (Q.)	
				Wet wt.	Dry wt.	Wet wt.	Dry wt.	Wet wt.	Dry wt.
1 Cyperus malaccensis	16622.39 SD. 1933.09	51.635	180459.2	2.557 SD. 0.84	0.974 SD.	425.03	161.90	4614.34	1757.67
2 Cyperus compressus	5369.84 SD. 624.12	16.679	58291.46	3.943 SD. 1.061	1.577 SD.	211.73	84.68	2298.43	919.25
3 Cyperus iria	10200.73 SD. 1186.09	31.684	110733.5	2.957 SD. 0.575	0.985 SD.	301.61	100.47	3274.38	1090.72

© 2016 Global Journals Inc. (US)

b) Outline of utilizing three sedges of Cyperus

In the villages of Pakhirala (405 ha) and Dulki (396 ha) of Gosaba island (7507 ha), 97 out of 520 and 53 out of 142 local families from backward community (Scheduled caste) were involved for 4 (SD. 1.5) months in mat making process. Whereas in case of Sadhupur (374 ha.) and Hamilton Abad (821 ha) villages of Sadhupur Island (5076 ha), 142 out of 1151and 58 out of 647 scheduled caste families were involved for 4 (SD 2) months in preparation of mats. They collected the raw materials mainly from nearby water bodies or in a few cases from their own pond banks where they had planted these sedges of C.*malaccensis* for one time in few years back. They generally collected the sticks of this species twice in a year (in the month of December and mid of June to July). Other two species (*C. compressus* and *C. iria*) were generally collected between October and November. The interactions/group discussions and collected answers of the sets of questionnaires from the local scheduled cast (backward community) of each village in these two island during the year 2014 and 2015, revealed that out of the total harvests, an average of 26% (SD 10.11) and 30 % (SD 8.52) of mat stick collection were utilized directly for their house hold use, while 74% and 70 % of the fresh weight flowed into the local market (Haats) for some cash income in the Gosaba and Sadhupur islands, respectively. Generally from each household, 1 person (80% SD 5 cases female) went to the nearby waterlogged areas to collect the sedges of these three *Cyperus* species. From the two year study it was observed that *C. malaccensis* was harvested maximum by the villagers (122.98 Q.) followed by *C. compressus* (47.72 Q.) and *C. iria* (21.33 Q.). They generally used Nylon thread (Rs. 90 kg-1) to stitch the mat prepared from *C. malaccensis*. This mat is generally made in large (3ft X 6ft) size which is much smooth and soft compared to the mat prepared from *C. compressus* or *C. iria*. *C. iria* was generally used to prepare small size mat of 3.24 sq. ft. (1.8 ft X 1.8ft) having a weight of 0.42 Kg. SD. 0.08 per pcs. mainly for using as 'Aasan' (small size mat).

c) Potentiality of ethnic Mat market

Out of 350 mat maker families of these two islands, about 20% of them found to prepare mat for using their own household needs, rest of the 80% were engaged in this livelihood option for household economy generation. Locally, a (3ft X 6ft) =18 sq. ft. mat of 2.3 kg dry weight of the mat sticks of *C. malaccensis* was purchased from the mat maker by only Rs. 140 SD.5 which was sold in the Gosaba *haat* at the rate of Rs. 202 (SD. 19) per mat and increased to Rs. 350 (SD. 22) in the urban markets. Here the first intermediater secured profit upto 41.42% (SD. 4.2) and the NTFP merchants in between the retail purchaser of Kolkata and the first intermediater of Gosaba market secured upto 73.26% (SD 3.4) of the production price of the mat. So approximately 150% of the mat production value was found to be occupied by different intermediators at different levels. In case of the mat (3.2 kg. dry weights per pcs.) prepared from the species *C. compressus*, which was generally found to be marketed in Gosaba, the gross profit of the intermediator 1 secured 36.75% (SD. 3.2) of the production value of the same. On the other hand, as the producers used to sell the mats prepared from *C. iria* directly to the local *haats* near to their residence, they secured maximum labor charges from that species but not getting more economic worth from this species compared to the other two species as it had only local demand (not flowed to the town or city markets). It was calculated after the cost-benefit and value chain analysis, using different value chain models (Table 3), the present value of *C. malaccensis*, *C.compressus* and *C. iria* is Rupees (Rs.)1673 per Q. of dry weight, Rs. 1125 per Q. of dry weight and Rs. 1303 per Q. of dry weight respectively. Sometime mat makers got the opportunity to sell the mats directly to the tourists visited to Sundarbans, where they received good profit.

Table 3 : Valuation of bioresources

Species	Bioresource valuation model used	Top level Market value (Rs./Q.)	Production +stitching material (Rs./Q.)	Profit of 1st Intermediate er (Gosaba market)	Profit of NTFP marchants (From 1st Intermediate to retail purchaser) (Rs./Q.)	Bioresource value (Rs./Q.)
1 *Cyperus malaccensis*	PV=TEV-(LC+TC+PI+PNM+VAS 2, TC=(TCC+TCI+TCNM), VAS2= VASC+VASI+VASNM	Value of 1 mat @ Rs. 350 of 2.3 Kg i.e. 15217/ Q. mat at different markets of Kolkata). (**Level 4 model**)	5108.69	2260	6177	1673
2 *Cyperus compressus*	PV=TEV-(LC+TC+VAS1+PI), TC=TCC+TCI, VAS1=VASC+VASI	Value of 1 mat @ Rs. 160 of 3.2 Kg i.e. 5007/Q. mat at Gosaba market. (**Level 3 model**)	2718	1156	-	1125

© 2016 Global Journals Inc. (US)

3. *Cyperus iria*	PV=TEV-(TCC+LC+VASC)	Value of 1 mat @ Rs. 20 of 0.42 Kg i.e. Rs. 4849/Q. mat at nearby *hatt* of Sadhupur. (**Level 2 model**)	3545.45	-	-	1303

It was calculated that the mean gross economic revenue generated to each of the mat making family from *C. malaccensis, C. compressus* and *C. iria* was Rs. 3089.96 Yr^{-1} (SD 118.49), Rs. 682.66 Yr^{-1} (SD 27.02) and Rs. 295.51 Yr^{-1} (SD 18.19) respectively. It was revealed from the two year data of the two island of Sundarbans that the mean Net Economic Revenue contributed by *C. malaccensis*, *C. compressus* and *C. iria* to each mat making family was Rs. 2389.96 Yr^{-1}, Rs. 575.66 Yr^{-1} and Rs 248.51 Yr^{-1} respectively which were 6.638%, 1.599% and 0.690% respectively of the total annual income of a family settled any of these two Island. As a whole, an estimation of 8.927% of the total annual income of a family of these two islands of Sundarbans was found to be generated from these three species of *Cyperus*.

Table 4 : Economic value summary in present condition (May be inserted after 4th paragraph of Results)

Species	Mean Actual annual production (Q.) in dry weight	Mean Actual annual utilization (Q.)	Mean market price Per kg	Mean gross revenue/ Family Rs/yr.	Mean cost/Q.	Mean net revenue/ Family. Rs./yr	Gross Economic Contribution/ Fam/Yr. (%)	Net economic Contribution / Fam/Yr. (%)
1 *Cyperus malaccensis*	161.90	61.49 X 2 = 122.98	87.94 Std : 15.01	3089.96	700	2389.96	8.583	6.638
2 *Cyperus compressus*	84.68	47.72	50.07 Std : 4.80	682.66	107	575.66	1.89	1.599
3 *Cyperus iria*	100.47	21.33	48.49 Std : 8.33	295.51	47	248.51	0.820	0.690
							GEC =11.2 9% /Fam/Yr.	NEC=8.927% / Fam/Yr.

IV. Discussion

All of the three species discussed here are either wild or semi wild (*C. malaccensis*) that does not imply any production cost. These species are almost abundant in the waterlogged area with moderately low salinity (3 ppt). Except the cost of stitching materials and labour cost, no other value added service is to be required to prepare the mat. Besides, no economically viable land like agricultural field is necessarily required for bulk production of these species. The two islands studied here, have the potentiality to increase the production of these three species near about 10 times of the present production, if local people allow their spreading or once sow the viable seeds/planted the rhizomes in the bank of ponds or other water bodies for growing and proliferation. The study reveals that these three species presently, as a whole, contributes 8.927% of the total annual income of a mat making family residing any of these two islands. As the villages are in remote places, it is quite difficult for the villagers to bring their prepared mats to the town market for sale where they may get more profit as the mats have well demand in the town markets like Jadavpur market (73.5 km away from Gosaba), Barabazar (87.2 Km away from Gosaba). Thus the local mat makers hand over their mats to some local intermediator at a low price. Actually, the two significant elements influencing bioresource valuation in India are the government policy and marketing infrastructure. Wild floristic resource is a state controlled subject, the pricing mechanism differs between states, which largely influence WFR value at farm gate (Hector, 1992). This supports significantly the present study also. Basically, the trading of mat from these species of *Cyperus* in the local market operates in an imperfect market system. Quantum of extraction of these species is often uneconomical and price was determined by local intermediate stakeholders. The pricing system where in force had no publicity leaving most of the traditional people of these two islands ignorant about the real demand and existing market for the product which results the local mat maker vulnerable to exploitation by unscrupulous intermediators and corrupt traders.

Moreover, Sundarbans, a unique geological and geographical terrain of the world mingled with significant bioresources supports the aboriginal people of that area to live in fragmented rural sets of distantly located islands. Natural calamities like Tsunami, Aila and other storms are the common threats that compel them to be environmental refugee for the time being that hinders traditional livelihood activities like agriculture for a prolonged period until the cultivable condition is restored. To overcome this adverse effect, use of the

© 2016 Global Journals Inc. (US)

sedges of three species of *Cyperus*, as represented in the present study, alternative livelihood options are adapted through which a sum of cash income is to be generated through mat preparation that have the potentiality to contribute a considerable percentage of the total annual income of the people of that areas. From group discussions it was estimated that the average income generated through paddy cultivation per hecter is Rs 17835 SD. 261.72 in case of high yielding variety and Rs. 7354 SD. 206.47 in case of indigenous variety. Whereas, the mean annual turnover from *C. malaccensis, C. compressus* and *C. iria* was calculated to be Rs. 82771.51 SD. 4075.05/ha, Rs. 77792.5 SD. 1651.09/ha and Rs. 94374 SD. 1627.76/ha respectively (Table - 3) with minimum investment of cash and labor compared to agricultural practice. Here in this comparison it should be noted that the actual and potential habitat of these 3 species of *Cyperus* in these two large islands is only 3.21 ha and 34.94 ha respectively as they are very specific to their habitat (only the wetlands and waterlogged areas with moderately low salinity level). Though the comparison does not implies any suggestion of substitution as the paddy is the staple crop and indispensable for the rural livelihood but the mat is not. Here the comparison used only to represent the potentiality of these three species of *Cyperus* to be an alternative livelihood option during the adverse period in those vulnerable remote islands.

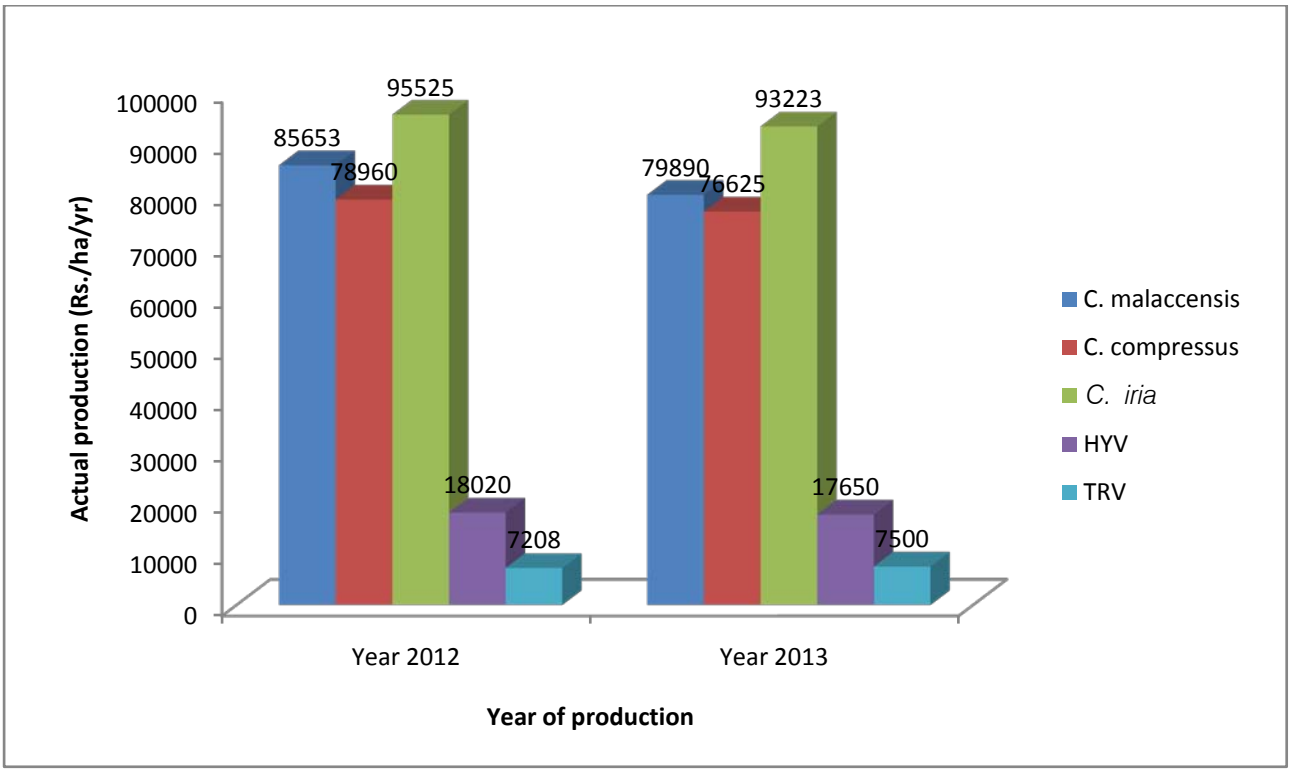

Fig 3 : Comparative study ofannual production of three *Cyperus* sedges with High Yielding Varieties and Traditional Rice Varieties

References Références Referencias

1. Alexander S.J., Pilz, D., Weber, N.S., Brown, E., Rockwell, V.A., 2002. Mushrooms, trees, and money: value estimates of commercial mushrooms and timber in the Pacific Northwest, Environmental Management, 30 (1), 129–141.
2. Banerjee A. K., 1964. Forests of Sundarban: Centanary Volume, Calcutta: West Bengal Forest Department, 166- 185.
3. Godoy R. & Bawa K.S., 1993. The economic value and sustainable harvest of plants and animals from the tropic rain forest: Assumptions, hypotheses, and methods, Economic Botany, 47:220-233
4. Bhattacharya P, Sayed F. Hayat., 2004. Sustainable NTFP Management for Rural Development: A Case from Madhya Pradesh, India, Int for Rev, 6: 161-168.
5. Byron N. & Arnold M., 1999. What Futures for the People of the Tropical Forests? World Development 27(5): 789–805. [Available at:http://www.sciencedirect.com/science/article/B6 VC63X5H9R5T/1/bf61a1f4c750269e58bcc1ddef8769ee (Retrieved 6th, May 2008)].
6. Census of India 2011. Government of India, New Delhi.
7. Chakraborty K., 1986. Fish and fishery resources in the mangrove swamps of Sundarbans, West

© 2016 Global Journals Inc. (US)

Bengal- an indepth study. Indian Forester, 112: 538-542.
8. Charlie S. & Sheona S., 2004. The importance of Non-Timber Forest Products in rural livelihood security and as safety nets: A review of evidence from South Africa. South Africa J of Science, 100: 58-664.
9. Chaudhuri A. B. & Choudhury A., 1994. Mangroves of the Sundarbans. Volume One. In: M ZakirHussain, G Acharya (Eds.): IUCN- The World Conservation Union. Bangkok, Thailand.
10. Goss J.D., 1996. Introduction to focus groups. Area 28(2): 113–114.
11. Gowdy J.M., (2007). Toward an experimental foundation for benefit-cost analysis. Ecological Economics 63(4): 649-655
12. Grix J., 2004. The Foundations of Research. Palgrave Macmillan, London.
13. Hector J., 1992. Contingent valuation at the farm gate. 36th Annual Conference of the Australian Agricultural Economics Society, Canberra.
14. Mahapatra A & Tewari, D., 2005. Importance of Non-Timber Forest Products in the economic valuation of dry deciduous forests of India. Forest Policy and Economics 7(3): 455-467.
15. Mandal A. K. & Ghosh R.K., 1989. Sundarbans: A Socio-bio- Ecological Study. Bookland Private Ltd., Calcutta.
16. Manna S., Roy A., Ghara T. K., 2012. Mangrove community in an abandoned brick kiln: A structural and association analysis, Eurasia J Biosci 6:24-31
17. Manna S. & Roy A., 2013. Economic contribution of wild edible mushrooms to a forest fringe ethnic community in some eastern lateritic parts of India. Journal of Forest Research, 19(1):52-61
18. Marshall C. & Rossman G., 1999. Designing Qualitative Research Sage Thousand Oaks, California.
19. Naskar K. R., Guha Bakshi D. N., 1982: Sundarbans – the world famous mangrove forests of the District 24- Parganas in West Bengal. Journal of Economic Taxonomic Botany, 3: 883- 918.
20. Peters C, Gentry A. H., Mendelsohn, R. O., 1989. Valuation of an Amazonian rain forest. Nature 339: 655-656.
21. Report of the working group on agricultural marketing infrastructure, secondary agriculture and policy required for internal a and external trade for the XII five year plan 2012-17, Agriculture division, Planning commission, Government of India, December 2011.
22. Singh A., Bhattacharya P., Vyas P., Roy S., 2010. Contribution of NTFPs in the Livelihood of Mangrove Forest Dwellers of Sundarban. Journal of Human Ecology, 29(3): 191-200.

Image 1 : Mat prepared from Cyperus species for domestic and commercial use

Image 2 : Collection of *Cyperus* for mat preparation

© 2016 Global Journals Inc. (US)