Production Economics of Mat-Sedges (Cyperus Tegetum Roxb.) Cultivation as Influnced by Water Management Practices for Economic Stability of Resource-Poor Rural People of West Bengal, India

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Abstract— *Mat-sedges are cultivated mostly by the resource-poor farmers in parts of West Bengal. Cultivation of mat-sedges provides a gainful employment to the rural economy, supplements the low income of the farmers and supports their livelihood. From the literature, preliminary survey and contact with the farmers at Sabong and Pingla of Paschim Medinipore district, where it is being widely cultivated mostly as mono-crop with poor management practices by the poor and marginal farmers, which resulted poor returns (Jana and Puste, 2012). Mandal (1986) reported that application of irrigation water according to physiological growth stages of the crop, particularly during the drier months for their growth and productivity. So, on the basis of this fact, a field experiment was conducted during 2006 (May) to 2008 (May) at farmer's field at Bural under Sabong block of Paschim Medinipore district, West Bengal on clay loam soil. In this experiment annually 3 cuttings were taken, viz. at the end of kharif, winter and summer season, respectively. Regarding production economics, highest BCR value of 1.89 and 2.93 were obtained from the treatment W6 [W3 (Rainfed during kharif + 2 irrigations during winter + 3 irrigations during summer) + rice straw mulching during winter and summer season, respectively] during 1st and 2nd year, respectively. Conversely, the lowest BCR value of 1.11 and 1.97 were obtained with the treatment W2 (Rainfed during kharif + one life-saving irrigation during winter and summer, respectively) during 1st and 2nd year, respectively.*

Keywords— Mat-sedges cultivation, Production economics, Water management practices, Benefit-cost ratio (BCR), Economic stability and Employment opportunity of rural people.

I. INTRODUCTION

The major thrust falls on agricultural sector, being dominated by agriculture. But presently, agriculture is facing disguised and under employment problems. Growing of mat-sedges for mat making provides wonderful opportunity for the betterment of employment potential of rural people (Sarkar and Samanta, 1987). The culms of mat-sedges are split into two or three pieces, and then woven into mats. The mat manufacturing industry is still continued to villages of few district of Chennai (Madras), West Bengal and Kerala, needs more expansion to other parts of India, particularly for uplift of the resource poor rural people through income generation scheme. Plain white mat with or with-out coloured boarder made from culm of Cyperus tegetum Roxb. is known as Calcutta mat in foreign market and earn foreign money. Mats are generally woven by the aged family members of either sex of a farmer's family and can earn a net income of Rs. 60 – 80/- per day from this job (Puste, 2004). Cyperus tegetum Roxb., which is abundantly found in India in marshy areas (Watt, 1889). Mat-sedges, a minor farm product are cultivated mostly by the resources-poor farmers in parts of West Bengal. It is mainly produced in Paschim Medinipur district (Sabong, Pingla and Narayangragh) and some areas of North 24 Parganas (Habra, Nagar Ukhra, Gaighta etc.). Cyperus tegetum Roxb. belongs to the family cyperaceae (Haines, 1962). The plant can thrive a wide range of agro-climatic conditions and occurs in marshy situations specially in Eastern and southern parts of India (Anonymous, 1929). The plant is capable of tolerating extremities such as prolonged submergence in water and extended drought conditions. Cyperus tegetum Roxb. differ from Cyperus corymbosus Rottb., locally named as 'Korai' which is used for mat making in Tamil Nadu (Amalraj, 1985) and having much more distinct glumes, which in the dried specimen have the margins incurred, not overlapping.

1. Economic importance:

Except mat making species, several of these are edible. Other offered aromatic tubers, which are employed on account of that property in perfumery. It is used in dyeing and in medicine eg., Cyperus nundates Roxb. Besides mat making, Cyperus sp. Is also used for different purposes. The tubers are used as a diaphoretic and astringent. The tubers are used for the preparation of tonic and stimulating medicine.

2. Value added products from mat-sedges

Several valuable decorative products (>50 types, viz. different types of windows screen, ladies & gents bag, mobile & cover file, hats, water carrying bags, money purse, shoes, pen stand, flower vas etc.) other than mattress are being made, which are now exported to foreign countries and marketed in the different parts of the country. It is an alternative good source of economic return, which may able to improve their livelihood.

3. Utility

In hot humid climate like our country, mats are very comfortable when spread over the hot, cold or damp earthen or cemented floor, or even on cotton beddings, as they are bad conductors of heat. These are also easy accessible to the common people of our country, because it is comparatively cheaper, can afford even by poor section of the people. A single mat more or less it lasts about 3-4 years at a stage of use. Now a days, most decorative with colourful mats are available in the market are used in most religious and ritual functions of our country (Puste, 2004).

4. Agro-Economics

The marginal and sub-marginal lands along with cultivable wastelands may be profitably used for its cultivation. Good quality lands are more suitable for growing of important economic crops. But the poor quality lands are kept vacant for a greater part of the year owing to a large number of agro-economics factors. Introduction of mat-sedges cultivation on such poor type of lands would go a long way in achieving economic well being of the farmers. Moreover, its cultivation is remunerative with the least investment in contrast to the cultivation of other crops like paddy, wheat etc. on per unit area. The ratoon (regeneration) crop also succeeds for 5 to 6 years with successive returns and even it may continue to produce economically for 10 to 15 years under better management practices. The mats are generally used for sitting as well as bedding purposes. In hot climate mats are very comfortable because of their heat non-conducting properties and ability to absorbed sweating. A common mat generally cost of Rs. 50 to Rs. 80/-. while, a designed and embroidered mat cost of Rs. 300 to Rs. 2000/-. In rural areas of Paschim Medinipur have gained wide popularity and even enjoyed president's Award for its quality and artistic work. The profit under good management conditions may be much higher than a farmer can get by growing two crops of rice per annum. Growing of raw materials including processing, drying and bundling of harvested culms is very labour intensive. The splitted and dried mat-stick may be immediately used for making mat or may be kept for use in the off time of the season, when there is no other farming operations (Anonymous, 1988). Even an older man or woman in rural areas can earn a net income of about Rs. 60 to Rs. 80/- per day. In low-lying situations in the Eastern region, the productivity of rice is not high and utilization of land by growing mat-sedges for mat making provide an alternative use of such marshy areas, accuring more profit and employment to the rural people. After full establishment of this crop in the field, it may possible to take 3 cuttings for their economic return. Annually 3 cuttings are taken, viz. first cutting in the end of September (kharif), second in the end of January (winter) and lastly third cutting in the end of May (summer). Three-season's mat-sedges crops are cultivated, viz. kharif season (June to end of September) and subsequent winter season (October to end of January) and summer season (February to end of May) (Jana and Puste, 2012).

From their practice, it proven that this crop is raised as part their traditional practice without much care. The production of sedges for mat making is not posing a technically sound practice at present, needs improvised agro-techniques including selection of rhizomes (Planting materials), better soil condition, transplanting, proper mid-term care, application of manures and fertilizers, water management practices including life-saving irrigation, need based plant protection measures, well enable to raise the production of sedges more than two folds with better quality. Specifically, application of irrigation during drier months of the year improved growth and productivity of mat-sedges (Jana and Puste, 2012).

II. MATERIALS AND METHODS

A field experiment was conducted to study the effect of water management practices on mat-sedges (Cyperus tegetum Roxb.) under old alluvial zone of West Bengal during 2006 – '07 to 2007 – '08 at farmer's field at Bural under Sabong block of Paschim Medinipur district, West Bengal, India on clay loam soil. The basic objective of this experiment is to explore means to improve production and productivity of mat-sedges farm through intensified irrigation facilities. The experiment was laid out in randomized complete block design (RCBD) with six different types of water management practices [W1 – Farmer's Practice (Rainfed during kharif + one irrigation during winter + 2 irrigations during summer); W2 – Rainfed during kharif + one life-saving irrigation during winter and summer, respectively; W3 – Rainfed during kharif + 2 irrigations during winter + 3 irrigations during summer; W4 – Rainfed during kharif + 3 irrigations during winter + 4 irrigations during summer; W5 – W2 + rice straw mulching (@ 4t ha-1) during winter and summer season, respectively; W6 – W3 + rice straw mulching (@ 4t ha-1) during winter and summer season, respectively] were carried out randomly with four replications. The irrigation

water is effective, particularly during the drier months of the year. So, a precise irrigation according to need based and physiological growth stages of the crop was provided for better growth and yield. For this, excess rainwater was conserved in excavated two harvesting ponds (50m x 20m x 3m) in adjacent of experimental area for subsequent use by the crop for providing life-saving irrigation and need-based irrigations. Pooled analysis was made from two consecutive years data of three seasons, namely kharif (2006 and 2007), winter (2006-'07 and 2007-'08) and summer (2007 and 2008), respectively.

[**Note:**

One irrigation: After cutting (previous crop) at tiller initiation stage (12 – 15 DAC) during winter and summer,

Two irrigations: 1st and 2nd at tiller initiation and maximum tillering stage (70 DAC),

Three irrigations: 1st, 2nd and 3rd at tiller initiation, tillering (40 DAC) and at maximum tillering stage, respectively and

Four irrigations: 1st, 2nd, 3rd and 4th at tiller initiation, tillering, maximum tillering and at inflorescence initiation stage (90 DAC), respectively.]

III. RESULTS AND DISCUSSION

The experiments were conducted over a period of two consecutive years basically using crop season wise data on frequency and timing of irrigation, climate regime characteristics and varying packages of water management practices as major input variables. Production economics is the most important phenomenon to judge the best one among the treatment variables. It includes cost of production, gross monetary return (GMR), net monetary return (NMR) /net profit and benefit-cost ratio (BCR) of the system. It is the most important factor for adopting the cultivation practice of a particular crop in a specific zone. Based on the market value of the produce, the gross monetary return (Rs. ha-1) of the treatment variable were calculated and from the calculation, it might thus possible to evaluate for economic consideration for the adoption of suitable agro-techniques for the benefit of the rural sector of the zone as a whole.

TABLE 1. DRY MAT-STICK YIELD (T HA-1) OF MAT-SEDGES AS INFLUENCED BY WATER MANAGEMENT PRACTICES

Treatments	Dry mat-stick yield (t ha^{-1})											
	kharif season			Winter season			Summer season			Total yield (t ha^{-1})		
	2006	2007	Pooled	2006-07	2007-08	Pooled	2007	2008	Pooled	1st Year	2nd Year	Pooled
W_1	3.652	3.785	3.718	1.082	1.157	1.120	2.127	2.154	2.141	6.861	7.096	6.978
W_2	3.646	3.748	3.697	1.078	1.113	1.095	1.447	1.465	1.456	6.171	6.326	6.248
W_3	3.622	4.125	3.873	1.673	1.778	1.725	2.842	2.862	2.852	8.137	8.765	8.451
W_4	3.637	4.253	3.945	2.108	2.235	2.171	2.962	2.996	2.979	8.707	9.484	9.095
W_5	3.654	4.012	3.833	1.696	1.812	1.754	2.297	2.313	2.305	7.647	8.137	7.892
W_6	3.641	4.354	3.997	2.194	2.304	2.249	3.342	3.365	3.353	9.177	10.023	9.6

TABLE 2. PRICE RATE OF MAT-STICK ACCORDING TO HEIGHT

Range of height	Weight of bundle (kg)	Rate per bundle (Rs.)	Rate per kg (Rs.)
60 – 70 cm	9 kg	108.00	12.00
71 – 80 cm	9 kg	135.00	15.00
81 – 90 cm	9 kg	180.00	20.00
91 – 100 cm	9 kg	207.00	23.00
101 – 113 cm	9 kg	234.00	26.00
> 114 cm	9 kg	252.00	28.00

TABLE 3. COST OF PRODUCTION OF MAT-SEDGES AS INFLUENCED BY WATER MANAGEMENT PRACTICES

Treatments	Cost of production (Rs. hectare^{-1})							
	1st year (2006 – 2007)				2nd year (2007 – 2008)			
	A. Kharif	Winter	Summer	Total cost (Rs.)	*B. Kharif*	Winter	Summer	Total cost (Rs.)
W_1	40,734.00	10,394.00	14,810.00	65,938.00	23,914.00	10,394.00	14,810.00	49,118.00
W_2	40,734.00	10,258.00	11,618.00	62,610.00	23,778.00	10,258.00	11,618.00	45,654.00
W_3	40,734.00	13,382.00	18,138.00	72,254.00	24,594.00	13,382.00	18,138.00	56,114.00
W_4	40,734.00	15,554.00	18,882.00	75,170.00	24,934.00	15,554.00	18,882.00	59,370.00
W_5	40,734.00	15,318.00	17,290.00	73,342.00	24,390.00	15,318.00	17,290.00	56,998.00
W_6	40,734.00	17,558.00	22,110.00	80,412.00	25,274.00	17,558.00	22,110.00	64,942.00

TABLE 4. GROSS MONETARY RETURN (GMR) OF MAT-SEDGES AS INFLUENCED BY WATER MANAGEMENT PRACTICES

Treatments	Gross monetary return (Rs. hectare^{-1})							
	1st year (2006 - 2007)				2nd year (2007- 2008)			
	A. Kharif	Winter	Summer	Total GMR (Rs.)	*B. Kharif*	Winter	Summer	Total GMR (Rs.)
W_1	1,02,256.00	12,984.00	31,905.00	1,47,145.00	1,05,980.00	13,884.00	32,310.00	1,52,174.00
W_2	1,02,088.00	12,936.00	17,364.00	1,32,388.00	1,04,944.00	13,356.00	17,580.00	1,35,880.00
W_3	1,01,416.00	25,095.00	56,840.00	1,83,351.00	1,15,500.00	26,670.00	57,240.00	1,99,410.00
W_4	1,01,836.00	42,160.00	68,126.00	2,12,122.00	1,19,084.00	44,700.00	68,908.00	2,32,692.00
W_5	1,02,312.00	25,440.00	34,455.00	1,62,207.00	1,12,336.00	27,180.00	34,695.00	1,74,211.00
W_6	1,01,948.00	43,880.00	86,892.00	2,32,720.00	1,21,912.00	46,080.00	87,490.00	2,55,482.00

TABLE 5. PRODUCTION ECONOMICS OF MAT-SEDGES AS INFLUENCED BY WATER MANAGEMENT PRACTICES (HECTARE-1 BASIS)

Treatments	Total cost of production (Rs.)		Total GMR (Rs.)		Total NMR (Rs.)		B – C ratio	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
W_1	65,938.00	49,118.00	1,47,145.00	1,52,174.00	81,207.00	1,03,056.00	1.23	2.09
W_2	62,610.00	45,654.00	1,32,388.00	1,35,880.00	69,778.00	90,226.00	1.11	1.97
W_3	72,254.00	56,114.00	1,83,351.00	1,99,410.00	1,11,097.00	1,43,296.00	1.53	2.55
W_4	75,170.00	59,370.00	2,12,122.00	2,32,692.00	1,36,952.00	1,73,322.00	1.82	2.91
W_5	73,342.00	56,998.00	1,62,207.00	1,74,211.00	88,865.00	1,17,213.00	1.21	2.05
W_6	80,412.00	64,942.00	2,32,720.00	2,55,482.00	1,52,308.00	1,90,540.00	1.89	2.93

[**W_1** – Farmer's Practice (Rainfed during *kharif* + one irrigation during winter + 2 irrigations during summer); **W_2** – Rainfed during *kharif* + one life-saving irrigation during winter and summer, respectively; **W_3** – Rainfed during *kharif* + 2 irrigations during winter + 3 irrigations during summer; **W_4** – Rainfed during *kharif* + 3 irrigations during winter + 4 irrigations during summer; **W_5** – W_2 + rice straw mulching (@ 4t ha^{-1}) during winter and summer season, respectively; **W_6** – W_3 + rice straw mulching (@ 4t ha^{-1}) during winter and summer season, respectively]

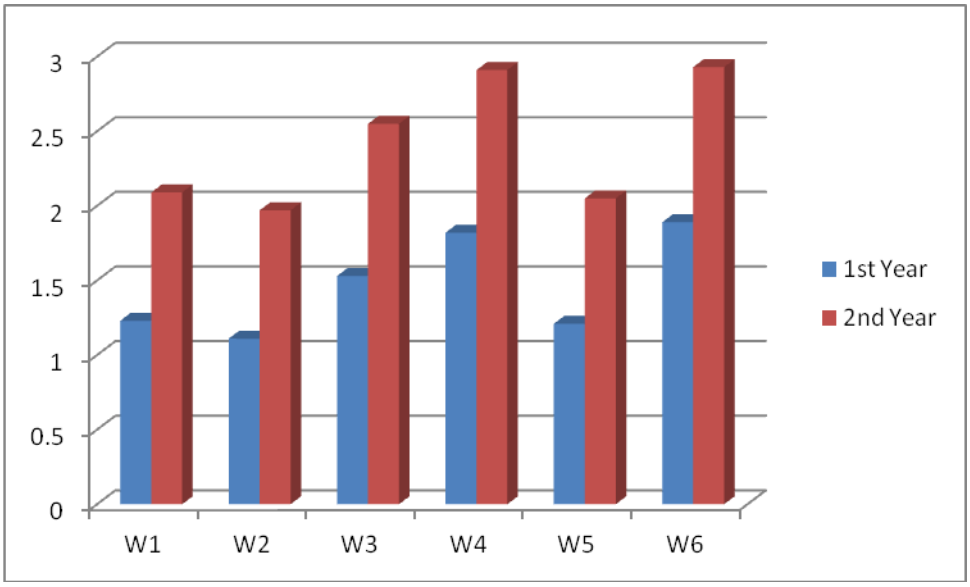

FIG. 1 B-C RATIO OF MAT-SEDGES CULTIVATION AS INFLUENCED BY WATER MANAGEMENT PRACTICES

The experimental results revealed that the dry mat-stick yield of mat-sedges was significantly differed by different water management practices (Table 1). The highest dry mat-stick yield of mat-sedges was recorded from treatment W6, where 2 and 3 irrigations were applied along with rice straw mulching during winter and summer season, respectively. The lowest dry mat-stick yield of mat-sedges was obtained with treatment W2 (Rainfed during kharif + one life-saving irrigation during winter and summer, respectively). It was significantly lower than other treatments of water management practices. There was a yield increment in W6 treatment to the tune of 130.96, 129.70 and 130.29% over W2 treatment at summer season during 2007, 2008 and pooled value, respectively. Price of mat-stick is depending on the height of dried mat-stick. Highest price rate was obtained from long mat-stick (Table 2). Because, the plant height is more important, which determine the original width of a hand-made mat, as the market price of the hand-made mat varies according to its width. The highest value of total cost of production of mat-sedges cultivation and total gross monetary return for two consecutive years (kharif, winter and summer seasons of 1st and 2nd year) were recorded from the treatment W6 [W3 (Rainfed during kharif + 2 irrigations during winter + 3 irrigations during summer) + rice straw mulching during winter and summer season, respectively) (Table 3 and Table 4).

The highest value of total [for three consecutive seasons (kharif, winter and summer seasons of 1st and 2nd year)] net monetary return (Rs.1,52,308.00 and Rs.1,90,540.00 during 1st and 2nd year, respectively) was obtained from the treatment W6 [W3 (Rainfed during kharif + 2 irrigations during winter + 3 irrigations during summer) + rice straw mulching during winter and summer season, respectively) followed by W4 (Rainfed during kharif + 3 irrigations during winter + 4 irrigations during summer) (Table 5). Total net monetary return of Rs.1, 36,952.00 and Rs.1, 73, 322.00 during 1st and 2nd year, respectively were obtained from the treatment W4. The lowest total NMR (Rs.69,778.00 and Rs.90,226.00 during 1st and 2nd year, respectively) was obtained from treatment W2 (Rainfed during kharif + one life-saving irrigation during winter and summer season, respectively). Regarding the benefit-cost ratio (BCR), the highest values (1.89 and 2.93 during 1st and 2nd year, respectively) were obtained from the treatment W6, closely followed by the treatment W4. The lowest BCR values (1.11 and 1.97 during 1st and 2nd year, respectively) were obtained from the treatment W2, where crop grown under rainfed condition during kharif season and one life-saving irrigation was applied at tiller initiation stage during winter and summer season, respectively (Table 5 and Fig.1).

IV. CONCLUSION

The profitability of this system can be increased, if the farmers really acquainted for using their own resources with need based investments for the purpose. Thus, the following conclusion can be drawn from this experiment:

The highest net monetary return and BCR value were obtained with W6 treatment [W3 (Rainfed during kharif + 2 irrigations during winter + 3 irrigations during summer) + rice straw mulching during winter and summer season, respectively].

Considering yield performance, production economics and water economy, it may be concluded that rice straw mulching @ 4t ha-1 is considering beneficial for small and marginal farmers.

Application of rice straw mulching with higher frequency of irrigation (2 irrigations during winter and 3 irrigations during summer, respectively) enhanced the dry mat-stick yield of mat-sedges to a greater tune and also improved the monetary returns, economic status and stability of resource-poor farming community of rural area.

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