

Research Paper

Economics of Vetiver Cultivation: Increase in the Income of Household from Marginal Land in Madhepura District of Bihar

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ABSTRACT

The study was conducted in Madhepura district of Bihar to understand the socio-economic status of vetiver growers, profile of inputs used, relationship between cost and return, influence of input's cost on yield and returns of vetiver. The study is absolutely based on primary information, collected from 70 farmers those who are benefited by CSIR-CIMAP Aroma Mission. The data were collected through field visit and adopted the personal interview method. The statistical tools like, descriptive analysis, CACP cost concept and multiple regression function were used to attain the objectives of the study. The results revealed that literacy rate of farmers in the study area was 82.42 percent whereas 96.80 percent of overall sample farmers were dependent on agriculture and 3.20 percent on Non-farm sources. The majority of sampled farmers (94.29%) were belonging to general category. The average land holding size was found to be 2.60 hectare. In total land holding of farmers about 70.79 percent acreage devoted under cultivation of traditional crops and 29.21 percent under medicinal and aromatic crops like Satavari, Vetiver, Lemongrass, Mint, etc. The total cost of cultivation and gross return of vetiver were found to be ₹ 121475/ha and 289920/ha. The net return over Cost C_3 was found to be highest with ₹ 168445/ha followed by Cost B_2 , Cost C_2 , Cost C_1 , Cost B_1 and Cost A_1 . The benefit-cost ratio is observed to be highest (1: 3.05) at Cost A_1 it implies that the farmers obtained ₹ 3.05 as profit by investing ₹ 1 in vetiver cultivation. The lowest benefit-cost ratio was found at Cost C_3 (1:1.39) farmers obtained ₹ 1.39 return after investing one rupee. Total seven explanatory variables were considered in this study. Out of these variables, the regression coefficient of planting material, manures and fertilizer, number of irrigation, distillation method have positive influence on the yield and returns of vetiver. It was also observed that out of identified two marketing channels, Channel-I was dominated in the study area as 80.00 percent of vetiver growers were selling their vetiver oil through this channel and remaining 20.00 percent growers were selling vetiver oil through Channel- II. Thus, increase in income and employment through cultivation of vetiver may attract large number of farmers in the study area with integrated and traditional crops farming.

HIGHLIGHTS

- ① The net return over Cost C_3 was found to be highest to another cost.
- ② The benefit-cost ratio was observed to be highest at Cost A_1 and lowest at Cost C_3 .
- ③ The regression coefficient of planting material, manures and fertilizer, number of irrigation, distillation method have positive influence and other variable are insignificant and not influenced the yield and returns of vetiver by increase or decrease the investment.

Keywords: Aroma mission, aromatic crop, cost and return, regression function, marketing channel

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Vetiver is an important essential oil bearing aromatic crop and widely used in perfumery, flavour and fragrance industries. In India, vetiver oil is commercial produced state in Uttar Pradesh, Rajasthan Bihar, Tamil Nadu Andhra Pradesh, Karnataka and Kerala. The major vetiver oil producing countries are Indonesia and Haiti (CIMAP farm bulletin 2007). However, (Suresh R. et al. 2012) reported that net returns over total cost have been found higher for vetiver followed by menthol mint and tulsi crops. It is a dense, clumping perennial grass and planted in tropical and sub-tropical condition and soil even in very acidic, saline and alkaline soil with pH of 8.5 to 9.8. It can also be cultivated on clay loam soil and variety of problematic soils like waterlogged soils, sandy soils with high water table and flood prone. The well-drained loam soil and red lateritic soils rich in organic matter have considered ideal for cultivation. It is tolerant to a wide range of temperature but optimum temperature needed for good root growth is 25°C. Due to its extensive and deep root system, vetiver is tolerant prolong drought period and can be grown in area with an annual rainfall from 450 mm and higher. Vetiver is sensitive to shade and this will slow growth, especially in young plants.

The present study was conducted in Madhepura district of Bihar. As we know that, Bihar is India's most flood-prone state, with more than one-third population in the North Bihar living under the recurring threat of flood devastation. These phenomenons make the agricultural activities tedious and resulting farmers and agricultural labours migrate from the villages. Considering these problems as secure the livelihood and income of farmers, CSIR-CIMAP, Lucknow introduced one of major aromatic crop 'Vetiver' in Madhepura district under the project CSIR-Aroma Mission. This crop can be easily cultivated on waterlogged soils, sandy soils with high water table and flood prone. The present study was focused to assess the socio-economic profile of farmers, inputs used for vetiver cultivation and to identify the determinants of vetiver yield.

MATERIALS AND METHODS

Under Aroma Mission, during 2018-19 CSIR-CIMAP demonstrated the vetiver cultivation in Madhepura district of Bihar on 70 farmers'

field of five villages. For adoption improved practices of vetiver cultivation towards higher yield, CSIR-CIMAP organised number of farmers training and provided the package of practices of vetiver cultivation to each farmers. The study was predominantly based on primary data collected from the all vetiver cultivated farmers through field visit and adopted the personal interview method. To achieve the objectives of the study, the cost and returns for vetiver cultivation was worked out based on CACP cost concept by using various costs such as cost $A_1, A_2, B_1, B_2, C_1, C_2$ and C_3 . In order to determine the input-output relationship, the multiple linear production function was used in following form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + U_i$$

Where,

α = Intercept

Y = Yield of vetiver oil (Kg/ha)

X_1 = Human manpower charges (₹/ha)

X_2 = Machine/Tractor (₹/ha)

X_3 = Planting material (slips) (₹/ha)

X_4 = Manure & Fertilizer (₹/ha)

X_5 = Irrigation (₹/ha)

X_6 = Distillation charges (₹/ha)

X_7 = Transportation charges (₹/ha)

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7 are unknown parameters (constants to be estimated from the data), U_i = Vector of random disturbance term

RESULTS AND DISCUSSION

Socio-economic status of farmers and profile of input use

The socio-economic status of vetiver cultivated was estimated through various parameters, which have highlighted the production visage like average family size, literacy status, occupation, caste, average land holding, cropping pattern and average farm assets The results of all these parameters has been presented in table 1. It is revealed that the overall average family size was found 2.58 persons, literacy status of family member was 82.42 percent, and more than two third (96.80 %) population

of the study area was absolutely dependent on agriculture. The average land holding of the sample farmers were found as 2.60 hectares. Followed by vetiver cultivation in the study area, mint, satavar and lemongrass occupied significant area in the cropping pattern and contributed about 29.21 percent area. The major investment was made by the farmers on the farm asset like farm building, irrigation structure, tractor, farm equipment and distillation units etc.

Table 1: Socio-economic profile of sampled farmers

Parameter	Averages
Family size (No.)	2.58
Literacy status (%)	82.42
Occupation (%)	
Agriculture	96.80
Other (Dairy, Services, Fisheries, etc.)	3.20
Caste composition (%)	
General	5.71
Other backward castes	94.29
Landholding (ha)	2.60
Cropping Pattern (%)	
Traditional crops (%)	70.79
Paddy	32.99
Wheat	16.64
Maize	15.25
Potato	3.97
Mustered	1.76
Pea	0.18
Medicinal and Aromatic crops (%)	29.21
Satavar and Lemongrass	0.55
Vetiver	0.37
Mint	14.42
Mint	13.86
Average farm assets ₹ (farm building, irrigation structure, farm equipment and distillation units)	336079

Costs and returns of vetiver cultivation

The costs and returns of vetiver cultivation were estimated based on CACP cost concepts. In cost of vetiver cultivation, both direct and indirect costs incurred on deployed inputs used by farmers were considered. Therefore, it was considering worthwhile to work out the net returns over various cost concepts viz., Cost A₁, A₂, B₁, B₂, C₁, C₂ and C₃. The total cost of vetiver cultivation was constituted by four major costs components like operational cost, material cost managerial cost and other costs. It is evident from table 2, that the operational cost was low as ₹ 23449/ha (19.31 per cent of cost C₃). In

operational of cost of vetiver cultivation, maximum cost was shared by human labour ₹ 15808/ha (13.01 per cent) followed by machinery labour ₹ 2519/ha (2.07 percent) and oil distillation charge of vetiver root was constituted by ₹ 5122/ha (4.22 percent). The total material cost was incurred in vetiver cultivation ₹ 41390/ha (34.07 per cent of cost C₃) in which highest cost shared by planting material (slips) as ₹ 32513/ha (26.77%) followed by irrigation charge ₹ 5520/ha (4.54 %), manures and fertilizer ₹ 3357/ha (2.76%). In Cost C₃, the maximum cost constituted by other cost as ₹ 45593/ha (37.53 per cent). In this cost, about 22 per cent cost shared by rental value of land, 12 per cent by interest on working and fixed capital invested by farmers during the production period, depreciation cost of farm building, machines and implements incurred by 3 per cent followed by transportation and land revenue tax (1.10 %) respectively.

Table 2: Cost structure of vetiver cultivation in Madhepura district of Bihar (₹ ha⁻¹)

Particulars	Amount (₹/ha)
Operation cost	
Human labour	15808 (13.01)
Machine labour	2519 (2.07)
Distillation	5122 (4.22)
Sub-total (a)	23449 (19.31)
Material cost	
Planting material (Slips)	32513 (26.77)
Manures and fertilisers	3357 (2.76)
Irrigation	5520 (4.54)
Sub-total (b)	41390 (34.07)
Other costs	
Transportation	1290 (1.06)
Interest on working capital	4629 (3.81)
Rental value of land	26500 (21.82)
Land revenue	46 (0.04)
Depreciation	3648 (3.00)
Interest on fixed capital	9480 (7.80)
Sub-total (c)	45593 (37.53)
Total (a+b+c)	110432 (90.00)
Cost C ₃	121475 (100.00)

Table 3 presents various costs incurred in vetiver cultivation according to cost concept given by 'Commission on Agricultural Costs and Price' and also discussed the yield, prevailing market price of vetiver oil and gross returns obtained by the farmers from vetiver cultivation. The perusal of the

table suggested that cost A_1 , which included cost of wage of family and hired labour, charge of owned and hired machinery, charges of planting material obtained from CSIR-CIMAP, Lucknow, Imputed and market value of owned and purchased manures and fertilizer, irrigation charges, interest on working and fixed capital, transportation charges, depreciation cost and land revenue tax was found to be ₹ 83932/ha. The cost A_1 was equal to cost A_1 because in the study area no case was found about the cultivation of vetiver on leased in land.

Table 3: Costs and Return of vetiver oil production

Costs, Yield and Return	Amount
Cost A_1	83932
Cost A_2	83932
Cost B_1	93412
Cost B_2	119866
Cost C_1	100242
Cost C_2	110432
Cost C_3	121475
Yield vetiver oil (Kg/ha)	24.16
Cost of vetiver production (₹/kg)	5027.95
Price of vetiver oil (₹/kg)	12000
Gross return from vetiver cultivation (₹/ha)	289920

Costs Structure of Vetiver Cultivation

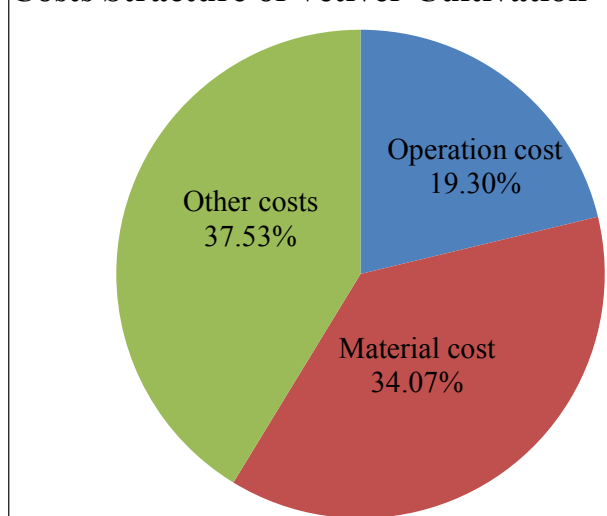


Fig. 1

Cost B_1 , which includes Cost A_1 or Cost A_2 and interest on amount of owned capital invested by farmers in vetiver oil production excluding the value of land was estimated to be ₹ 93412/ha. Cost B_2 included the cost of rental value of farmer's owned

land minus land revenue tax, was found to be ₹ 119866/ha. Cost C_1 in which includes Cost B_1 and imputed value of family labour was found to be ₹ 100242/ha. Similarly, in Cost C_2 includes Cost B_2 and imputed value of family labour was found to be ₹ 110432/ha. The total cost of vetiver cultivation (Cost C_3) was estimated to be ₹ 121475/ha it includes Cost C_2 and their managerial cost at the rate of 10 percent.

Yield and returns of vetiver cultivation

The economic yield of vetiver depends upon various factors like climatic condition, soil type, cultural practices, distillation time and methods adopted by farmers. However, study area is most suitable for vetiver cultivation towards the higher yield and returns. The average yield of vetiver oil obtained by famers was found to be 24.16 kg/ha. The return absolutely depends on yield and current market price of the produce. The average price received by the farmers was ₹ 12000/kg. Further, the gross return received in the cultivation of vetiver in the study area were ₹ 289920/ha. Table 4 represents net returns obtained by farmers from vetiver cultivation over the Cost A_1 , A_2 , B_1 , B_2 , C_1 , C_2 and C_3 . The net return over Cost C_3 was found to be highest with ₹ 168445/ha followed by Cost B_2 , Cost C_2 , Cost C_1 , Cost B_1 and Cost A_1 .

Benefit–cost ratio

The relationship between costs incurred in vetiver cultivation and benefit obtained by the farmers is represented in table 4.

Table 4: Net returns from vetiver cultivation over the costs

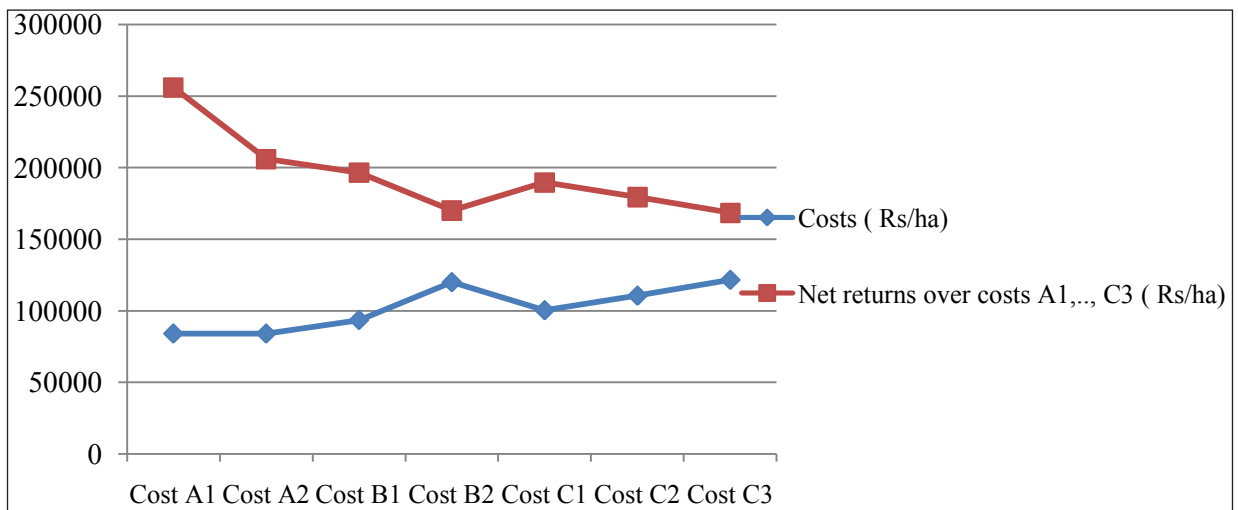
Costs (₹/ha)	Net returns over costs A_1, \dots, C_3 (₹/ha)	B:C ratio
Cost A_1 : (83932)	255988	1:3.05
Cost A_2 : (83932)	255988	1:3.05
Cost B_1 : (93412)	196508	1:2.10
Cost B_2 : (119866)	170054	1:1.42
Cost C_1 : (100242)	189678	1:1.89
Cost C_2 : (110432)	179488	1:1.63
Cost C_3 : (121475)	168445	1:1.39

The benefit –cost ratio was observed to be highest (1: 3.05) at Cost A_1 which implies that the farmers

Table 5: Estimated production factors for vetiver cultivation (N=75)

Parameters	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept (α)	-22774.832	24822.593	-0.918	0.362	-72394.488	26844.824
Manpower charges (X_1)	2.559	3.939	0.650	0.518	-5.315	10.434
Machine /Tractor (X_2)	-4.968	14.737	-0.337	0.737	-34.426	24.491
Slips (X_3)	3.273**	1.583	2.067	0.043	0.108	6.438
Manures and fertilizers (X_4)	33.579**	15.925	2.109	0.039	1.746	65.411
Irrigation (X_5)	10.370**	4.752	2.182	0.033	0.872	19.869
Distillation method (X_6)	15.629*	8.887	1.759	0.084	-2.135	33.393
Transportation (X_7)	-11.032	32.333	-0.341	0.734	-75.665	53.601
R ²	0.845					

* implies significant at 1% ($P<0.1$) and ** significant at 5% ($P<0.05$) level of probability.

**Fig. 2**

obtained ₹ 3.05 as return by investing ₹ 1 in vetiver cultivation. At the Cost C₃ farmers obtained ₹ 1.39 return. Thus, the vetiver cultivation in Madhepura district is considered to be profitable and financially feasible. It is better option and scope for utilization of marginal land and replacement of the crop that cannot be cultivated on marginal land.

Estimated resources use efficiency of vetiver cultivation

To determine the influence of inputs (explanatory or independent variables) used on vetiver yield (explained or dependent variable), the multiple regression function was used. The results of multiple regression function have been presented in Table 5. The coefficient of multiple determinants R² was 0.845, which indicated that 84.50 percent variation in vetiver yield have explained by all independent variables like human and machinery labour cost, planting material (slips), manures and

fertilizer, irrigation, distillation and transportation. The adjusted R² was 94.13% can be regarded as quite a good fit. The F-value was 7956.83 and highly significant at 5% level of significance, implies that the multiple regression model was well fitted in view of primary data involved in this study.

Out of seven independent variables, the regression coefficient of planting material, manures and fertilizers, number of irrigation, distillation method have positive significant at 5% and 10 % level of significance. The coefficients of these variables implies that, if cost of vetiver cultivation increase the output will also increase, keeping all other variables constant. The all other variables considered in regression model are insignificant and not influenced the yield and returns of vetiver by increase or decrease the investment.

Marketing channel

Distribution of sampled farmers adopting different

marketing channels to sale their produce was presented and two marketing channel were identified for the marketing of vetiver oil (table 6). It was observed that, out of these two identified marketing channels, Channel-I was dominated in the study area as 80.00 percent of vetiver growers were sold their vetiver oil through this channel and remaining 20.00 percent growers were sold vetiver oil through Channel- II. It is, therefore, apparent that local buyers act as middleman in this trade slicing away a major portion of the profit which may have gone to the producer. It is, therefore, imperative to link the producers directly with the user industries to ensure better market price to the producers.

Table 6

Marketing Channel	Sampled farmers	Percent
Channel-I: Producer- Local buyers- Industry	56	80.00
Channel - II: Producer -Industry.	14	20.00

CONCLUSION

Vetiver is considered as an important aromatic crop for livelihood security and income enhancement of farmers of Madhepura. It is well cultivated in marginal land and economically feasible. It is labour intensive crop, have great opportunities to create the employment especially for rural peoples. However, the adoption of improved production technologies and marketing system will be increased the production, expand the area under cultivation and income of farmers.

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