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Economics of Sustainable Vetiver Farming in East Champaran District of Bihar State

Ram Suresh Sharma*[1], Rushikesh N. Bhise[2], Mahesh M. Kadam[3], Ramesh K. Srivastava[4], Sanjay Kumar[5]

[1,2,3,4,5] Technology Dissemination & Computational biology CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow-226015

[1](ORCID ID: 0000-0002-3145-7164)

ABSTRACT: The vetiver is essential oil-bearing aromatic crop. The oil used in drinking product, soap, pharmaceutical, cosmetic, and perfumery industries in India. The study was carried out to the cost and returns on CACP cost concepts and statistical analysis basis of vetiver crop. The cost of cultivation to be found cost A_1 ₹ 1, 20,428/- (56.37 per cent per hectare and gross income of vetiver was found ₹4, 40,000/- hectare per year. The net return over Cost A_1 ₹319572/- and Cost C_3 was found to be ₹226371/- per hectare per year. The benefit cost ratio over cost A_1 and cost C_3 was found 1:2.65 and 1:1.06. This study was found that vetiver production is profitable venture in the study area. There are two marketing channel were found in the vetiver oil i.e. Producer-Local buyer-Industry and Producer- Industry. It was observed that vetiver oil was more selling through channel-II than channel-I like 80% and 20% respectively. The study, therefore, recommended that farmers should be encouraged to form the sustainable farming of cluster model system. This model multiplication in another problematic and unreached area in the various part of the country. For this crop cultivation improved their livelihood life in the study areas.

Highlights:

- Vetiver cost of cultivation cost C_3 was found to be highest followed by another cost.
- Net return over cost A_1 was found to be highest followed by another cost.
- The benefit cost ratio was observed to be highest cost A_1 and lowest cost C_3.
- The observed marketing cost was higher in channel-II followed by channel-I

KEYWORDS: Aroma Mission, oil production, cost and returns, marketing channel and regression function

INTRODUCTION

Vetiver is an important essential oil bearing aromatic crop and widely used in perfumery, flavour and fragrance industries etc. It can also be cultivated on clay loam, sandy soils and problematic soils like waterlogged soils with high water table and flood prone areas. The well-drained loam soil and red lateritic soils rich in organic matter have considered ideal for cultivation. Agriculture is the main source of income of the people in East Champaran (Motihari) like paddy, wheat, sugarcane and maize are the major crops of the study area. Apart from agriculture, animal husbandry and fishery development is one of the key sectors which are very important from the point of view of income and employment in the rural areas. The present study was focused on the socio-economic profile and resource structure of the farmers, to analysis the cost and returns and estimated the resource use efficiency in vetiver crop.

The major vetiver oil producing countries are Indonesia and Haiti. **(CSIR-CIMAP farm bulletin 2007).** However, reported that net returns over total cost have been found higher for vetiver followed by menthol mint and tulsi crops. **(Suresh R. *et al.* 2012).** It is observed that 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. (**Sharma R.S. *et.al.* 2022)**. MAPs based cropping systems in north India have shown that farmers gain significantly higher profits from their lands. **(Kothari *et al.,* 1987).** The growing demand for MAPs makes them remunerative alternative crops to the traditional ones for smallholders in the tropics. **(Rao *et al.* 2004).** It has been found that the returns are substantially higher from these crops than the most profitable commercial crops like sugarcane. It has been also suggested that concerted efforts should be made to address these constraints and increase access to the world market. **(Mittal *et. al.* 2007).** The rice, garlic, and mint cropping sequence increased net return, production efficiency, and benefit

as compared with other cropping sequences. **(Ram *et.al.*2008)**. There are specific herbs that are suitable for all problematic soils, waterloging, sodic, rainfed lands, dryland conditions and almost all kinds of unutilized and underutilized lands for better remuneration to the farming community. **(Kalaichelvi *et al.* 2009).** Based on demand and marketing opportunities for MAPs, farmers are advised to grow aromatic plants in large areas on a community basis to meet huge industrial demand and variety of medicinal crops in small areas to meet the requirement of traditional systems of medicine, **(Sujata *et al.* 2011).**

In India, it is cultivated Maharashtra, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Chhattisgarh, Haryana, Punjab, Rajasthan, Gujarat, Jharkhand, Uttar Pradesh Madhya Pradesh, Bihar, Arunachal Pradesh, Assam and Sikkim etc on around 4000 acres, with an annual oil yield of 250-300 tonnes. Vetiver oil is produced in small quantities across the world, with an annual production of estimated 1000 tonnes from a 16000 ha area. India is the largest producer in the world and about 80 percent of the produce has exported to more than 75 countries. This essential oil from India is being exported to major countries West Europe, U.S.A. and Japan, Belgium, Brazil, France, Germany, South Africa, Singapore, Spain, Switzerland and U.K. etc.

METHODOLOGY

CSIR-Central Institute of medicinal and aromatic plants, (CSIR-CIMAP) Lucknow in East Champaran district of Bihar undertook the technology demonstration on scientific cultivation of vetiver crop under Aroma Mission Phase- III during 2023-24. CSIR-CIMAP organised number of farmers awareness–cum-training provided the agro-practices and processing of vetiver cultivation. The primary data were collected from selected farmers' on inter cropping pattern and profit of vetiver crop cultivation. The sample of data collection in 45 farmers' fields through pre-schedule related to the economic aspects of the farmers. The investment and return were calculated at the prevailing market prices. A simple analytical tool and technique used for the data analysis method were followed to investment and returns of this crop cultivation. The economics was worked out by comparing investment and returns at different stages of economic aspects. The Multiple Linear Production function was used to evaluate the resource use efficiency in the production of vetiver crop cultivation.

Cost Concepts

Cost A_1 is All actual expenses incurred in the lemongrass cultivation.

Cost A_2 is Cost A_1 + rent paid for leased in land.

Cost B_1 is Cost A + interest on value of owned fixed capital (excluding land).

Cost B_2 is Cost B_1 + rental value of owned land.

Cost C_1 is Cost B_1 + imputed value of family labour.

Cost C_2 is Cost B_2+ imputed value of family labour

Cost C_3 is $_{Cost}$ C_2+ Managerial cost @10% of Cost C_2

The net returns over these cost concepts have been calculated as the difference between the gross farm income (GI) and particular cost.

GI = value of main product (quantity x price)

Net return including family labour = GI – total cost including family labour

Net return excluding family labour = GI – total cost excluding family labour

Farm business income = GI – Cost A_2

Family level income = GI – Cost B_2

Net farm income = GI – Cost C_2

Farm investment income = GI – Cost C_3

The Multiple Linear Production function was used to evaluate the resource use efficiency in the production of vetiver cultivation.

Multiple linear production function

$Y = \alpha+\beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + ...+ \beta nX_n$

α= Intercept

X_1 =Human manpower charges (₹/ha)

X_2 =Machinery/Tractor (₹/ha)

X_3 = Slips (₹/ha)

X_4 = Manure & Fertilizer (₹/ha)

X_5 = Irrigation charges (₹/ha)

X_6 = Distillation charges (₹/ha)

X_7 = Transportation charges (₹/ha)

β_1, β_2, β_3, β_4 , β_5 and β_6 are coefficient of dependent variable $X_{1.....}X_n$

RESULTS AND DISCUSSION

Socio-economic profile of the farmers

Data from the selected farmers were collected and analysed regarding average family size, literacy status, occupation, caste, average land holding, cropping pattern, average farm assets etc. are discussed below in Table 1.2. This table revealed that the overall average family size was found 6.00 persons, the literacy status of the family member was 72.58 per cent, and more than 86 per cent of the study area population was solely dependent on agriculture. The average landholding of the sample farmers was found as 3.45 hectares. Vetiver occupied an important position in the cropping pattern by representing about 20.54 per cent area during the year. The farmers made major investments in farm assets like farm building, irrigation structure, tractor, farm equipment and distillation units, etc.

Table 1. 2. Socio-economic profile of the farmers

Particulars		**Averages**
Average family size (No.)		6.00
Literacy status of family members (per cent)		72.58
Occupation (per cent)	Agriculture	86.34
	Allied sector (dairy plus services)	13.66
Caste composition (per cent)	General	2.70
	Other backward castes	6.70
	Schedule castes	48.00
	Schedule tribal castes	42.70
Average landholding (ha)		3.45
Agriculture crops (per cent)		70.42
	Paddy	17.98
	Wheat	3.71
	Maize	19.91
	Mustard	2.82
	Sugarcane	14.56
Medicinal and Aromatic crops (MACs) (per cent)		33.52
	Vetiver	20.54
	Mint	22.00
	Tulsi	4.37
	Lemongrass	3.10
Average farm assets (₹) (farm building, irrigation structure, farm equipment and distillation units)		350940

Cost Structure of Vetiver Cultivation

The cost structure of vetiver cultivation calculated at the current price prevailing in the market has been presented in Table 1.3. The observed operation cost of vetiver cultivation was Cost A_1 ₹ 120428/- (56.37 per cent) included cost of hired labour, machine and tractor, charge of planting material, manures and fertilizers, charge of irrigation, transportation distillation charge and interest of working capital in per hectare per year. In operation costs, the maximum expenditure incurred was of slips charges ₹ 41250/-ha (19.31 per cent), followed by hired labour charges ₹ 22800/ha (10.67 per cent), distillation charges ₹ 15500/ha (7.26 per cent), machine and tractor charges included digging ₹ 14500/ha (6.78 per cent) and manure and fertilizers ₹ 7000 (3.27 per cent), respectively in the study area. In cost C_3, the maximum cost is ₹ 213629/ha (100 per cent) followed by cost C_2 as ₹ 194208/ha (90.91 per cent).

Table-1.3. Cost structure of vetiver cultivation in Bihar

(₹ /ha per year)

Particulars	**Amount (₹)**	**%**

Hired manpower charges	22800	10.67
Machine /Tractor included digging charges	14500	6.78
Slips/Planting material	41250	19.31
Manures and Fertilizers	7000	3.27
Irrigation	6500	3.04
Transportation	5000	2.34
Distillation charges	15500	7.26
Interest on working capital @7per cent per annum	7878	3.68
Cost A_1	120428	56.37
Rent paid in leased land	-	-
Cost A_2	120428	56.37
Interest on fixed cost capital @10 per cent	11580	5.42
Cost B_1	132008	61.79
The rental value of own land	50000	23.41
Cost B_2	182008	85.19
Cost of family labour charges	12200	5.71
Cost C_1	144208	67.50
Cost of family labour charges	12200	5.71
Cost C_2	194208	90.91
Managerial cost @10% of Cost C_2	19421	9.09
Cost C_3	213629	100.00

Returns from vetiver cultivation

The cost and return from vetiver cultivation are presented in Table 1.4. It was found that the farmers have got 20 kg of vetiver oil from ha-1 of land, which amounted to a total return were ₹ 440000/- per hectare per year. The net return obtained by farmers from vetiver oil production over cost A_1, A_2, B_1, B_2, C_1, C_2, and C_3 show in table 4. The net income is over cost A_1 ₹ 319572/ha per year and C_3 ₹ 226371/ha per year. The relationship between costs incurred in vetiver cultivation and benefits received by the farmers is presented in table.1.4. The benefit -cost ratio over cost A1 was to be highest (₹ 1:2.65) and C_3 was lowest and (₹ 1:1.06) is respectively. Thus, the vetiver cultivation is considered to be profitable returns and financial feasible in selected area. It is better scope for unutilized of land diversified of the crop. This model multiplication in another problematic and unreached area in the various part of the country.

Table 1.4. Net return over cost (₹ per hectare per year)

Particulars	**Amount (₹)**		
Oil production (kg.)	22		
Price Rate (₹ per kg)	20000		
Gross Income (₹)	440000		
Cost concepts	**Costs**	**Net return over the cost**	**B:C ratio**
Cost A_1	120428	319572	1:2.65
Farm Business income (Cost A_2)	120428	319572	1:2.65
Cost B_1	132008	307992	1:2.33
Cost B_2	182008	257992	1:1.42
Family level income (Cost C_1)	144208	295792	1:2.05
Net farm Income (Cost C_2)	194208	245792	1:1.26
Farm investment income (Cost C_3)	213629	226371	1:1.06

Estimated Resource Use Efficiency for vetiver cultivation

The estimated resource use efficiency in vetiver production is presented in table 1.6. The multiple determination of the regressions coefficient's (R^2) value was estimated at 0.677, which indicates 68 per cent of the variations in vetiver yield were influenced by the explanatory variables included in the model. The independent variables like machine/tractor, slips /planting material, and manures & fertilizers were positive, indicating a significant impact on lemongrass oil returns in the study area. The coefficients of these variables implies that, if cost of vetiver cultivation increase the output will also increase, keeping all other variables constant.

Table 1.6: Estimated production factors for vetiver cultivation (N=45)

Variables	Coefficients	Standard Error	t Stat	P-value
Intercept (α)	-17750.86	14102.700	-1.259	0.213
Manpower charges (X_1)	1.814^{NS}	1.531	1.185	0.240
Machine /Tractor charges (X_2)	10.356**	4.994	2.074	0.042
Slips charges (X_3)	2.305***	0.679	3.396	0.001
Manures and fertilizers charges(X_4)	6.899*	3.822	1.805	0.076
Irrigation charges (X_5)	3.646^{NS}	5.228	0.697	0.488
Distillation charges(X_6)	22.020^{NS}	24.580	0.896	0.374
Transportation charges (X_7)	0.584^{NS}	3.150	0.185	0.853
R^2	0.677			
N	45			

Figures in parenthesis are standard errors

****, ** and * Significant at 1, 5 and 10 per cent level.*

NS: Non-significant.

Marketing system and Channel for vetiver production:

This section investigates the marketing system and channel of vetiver oil produced in the study area. The Marketing channels based on data collected from the grower, it was observed that vetiver oil reach to the ultimate industry through the following to various channels.

(i) Producer-Local buyers-Industry

(ii) Producer-Industry

Table-1.7: Marketing system (marketing channel) of vetiver oil produced by farmers:

Particular	Vetiver oil
Channel-I	36 (80.00)
Channel-II	09 (20.00)
Total	45 (100.00)

Out of these identified channels, table 1.7 shows that the Channel-I was dominated in the study area as 80 percent of vetiver growers were selling their oil through this channel and only 20 percent used channel- II to sell their oil at the selected study area. The growers received higher sell price by channel-II followed by channel-I. For grower's point of view, channel-II is most feasible and easy to sell their oil to traders. While for grower, channel-II is more profitable because less involvement of market cost margin and price spread.

CONCLUSIONS

It may be concluded that the major source of livelihood of the farmers has been found in agriculture and allied activity in the study areas. The farmers are inclined to faster adopt new crops and technologies for their livelihood improvement. Therefore, vetiver crop is profitable for the selected farmers of the study area. However, it is recommended from the present study that vetiver cultivation can be promoted in the study area. This type of model can be also adopted in another state where is problematic areas like unutilized land, rainfed area and animal affected areas. So, the cultivation of this crop can be improves their social and economical life.

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