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Resource use efficiency and level of technology adoption in lac cultivation among trained and untrained lac growers in Jharkhand

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The study is based on the primary data collected from randomly selected 500 lac growers (untrained and trained) in the Ranchi and West Singhbhum districts of Jharkhand in the year 2003-04 and 2004-05. The study has reported the cost, returns, resource use efficiency in lac cultivation on different host trees and level of technology adoption by trained and untrained lac growers. The net return in lac cultivation for 10 host trees by untrained lac growers was Rs. 977, Rs. 1954 and Rs. 16281 for *palas*, *ber* and *kusum*, respectively while, it was recorded around double in case of trained lac growers. The use of inputs in lac cultivation was in the rational zone of production for both trained and untrained lac growers on all the three hosts. The MVP of all the inputs used in lac cultivation for trained lac growers was higher than untrained lac growers for all the host trees except use of human labour in *kusum*. Significant increase has been found in case of trained lac growers regarding adoption of all improved lac cultivation techniques except *phunki* removal. The study has emphasized on the need of strengthening and widening the extension activity to empower the lac growers with scientific knowledge on lac cultivation, use of more inputs on the same host and promotion of *kusmi* lac cultivation for enhanced lac production, more income and employment generation at growers level.

Lac is a natural resin secreted by an insect known as *Kerria lacca* (Kerr.) thriving on the tender twigs of specific host trees *viz.*, *palas* (*Butea monosperma*), *ber* (*Zizyphus mauritiana*), *kusum* (*Schleichera oleosa*), *Ficus sp*. etc. *Rangeeni* and *Kusmi* are the two strains of lac insect which are based on preference of the insect for specific host plants. Lac is mainly cultivated in India, Thailand, Indonesia, parts of China, Vietnam, Cambodia etc. India is the leader in production and export of lac in the world. Major states engaged in lac cultivation in India are Chhattisgarh, Jharkhand, Madhya Pradesh, West Bengal and Maharashtra contributing around 95 per cent of national lac production. Minor states of lac production in India are Orissa, Uttar Pradesh, Assam, Meghalaya, Gujarat, Andhra Pradesh and contributing around 5 per cent of national production. The national production of lac was 20,640 tons during 2007-08. Jharkhand is one of the major producers of lac in the country contributing around 31 per cent of national production (Pal *et al*., 2008).

Lac cultivation is an important source of cash income for livelihood for the tribal lac growers inhabiting in forest and sub-forest areas. Besides it has high potential for generating employment for both men and women. It is a very remunerative crop, paying high economic returns to the farmers and also foreign exchange to the country through its export. The export earning from lac and its value added products during the year 2006-07 was around 148 crores. Lac is exported to more than 60 countries of the world and top ten importing countries of Indian lac are Egypt, Germany, Pakistan, Bangladesh, Indonesia, USA, Italy, UAE, Spain and Nepal.

Analysis of economics and resource use efficiency would be helpful in determining the marginal value productivity and optimum level of various inputs used for maximization of lac output. Level of technology adoption in lac cultivation also affects the output and profitability. However, information on resource use efficiency and level of technology adoption in lac cultivation is meagre. Keeping in view the above facts, the present paper examines the cost, return, resource use efficiency in lac cultivation on different hosts and level of technology adoption by trained and untrained lac growers.

The study is based on primary data collection from two major lac growing districts of Jharkhand, namely Ranchi and West Singhbhum, in the years 2003-04 and 2004-05. A total of 500 lac growers were selected and surveyed. Three stage stratified random sampling technique was adopted for the selection of blocks, villages and farmers. Four blocks from the selected districts, five villages from each selected block and ten lac growers from each selected villages were selected at random. Thus, the total number of selected untrained lac growers was 400. For comparative analysis of untrained and trained lac growers, 100 trained lac growers were selected randomly who had trained on scientific method of lac cultivation. Primary data were collected from the respondents using a well-structured and pre-tested

interview schedule. The costs and prices were based on the survey year. Average of two year prices was used for analysis of data.

To study the economics of lac cultivation, tabular analysis was followed. Production function analysis was used for determining the efficiency of various resources used in the process of lac production. The Cobb-Douglas production function was used due to higher value of coefficient of multiple determinations obtained.

The following form of production function equation was used for the analysis:

$$Y = aX_1^{b1}.X_2^{b2}.....X_n^{bn}$$

where, Y = Dependent variable (output values in rupees), X_i = i^{th} independent variable, input values in rupees (i = 1, 2, ……., n), a = Constant, b_i = Production elasticity with respect to X_i (i = 1, 2, ……., n)

The value of constant (a) and coefficient (b_i) in respect of independent variables in the function have been estimated by using the method of ordinary least squares (OLS). The marginal value of product (MVP) of inputs was estimated by taking partial derivatives of returns with respect to input concerned at the geometric mean level of inputs. The marginal value of product (MVP) was computed with the help of following equation:

$$\text{Marginal value of product (MVP)} = (b_i * \overline{Y})/ \overline{X}_i$$

where, b_i = Production elasticity with respect to X_i input, $\overline{Y}$ = Geometric mean value of Y (output values in rupees), $\overline{X}_i$ = Geometric mean value of X_i (input values in rupees)

The following formula was used to test the significance of trained lac growers regarding adoption of various techniques in lac cultivation

$$_i^2 = p[(O - E)^2 / E]$$

where, O = Adoption percentage of technique by untrained lac growers

E = Adoption percentage of technique by trained lac growers

All calculation regarding cost of cultivation is based on the lac cultivation on 10 host trees. The cost and returns in lac cultivation on different hosts by untrained and trained lac growers have been depicted in Table 1. The cost of lac cultivation for 10 host trees was Rs. 513 for *palas*, Rs. 935 for *ber* and Rs. 6881 for *kusum* for untrained lac growers and Rs. 707 for *palas*, Rs. 1592 for *ber* and Rs. 11042 for *kusum* for trained lac growers. Increased cost of cultivation in case of trained lac growers was due to utilization of more labour and broodlac. The net return for untrained lac growers was found to be Rs. 977, Rs. 1954 and Rs. 16281 for *palas*, *ber* and *kusum*, respectively, while for trained lac growers it was Rs. 1634, Rs. 4183 and Rs. 33129 for *palas*, *ber* and *kusum*, respectively. The BC ratio was found higher in case of trained than untrained lac growers on all the three hosts. Regarding lac cultivation on different hosts, highest BC ratio was found in both the cases, *i.e.* trained and untrained lac growers for lac cultivation on *kusum*, followed by *ber* and *palas*.

The production elasticities, standard error and coefficient of determination for lac cultivation on different host by untrained and trained lac growers have been presented in Table 2. Coefficient of determination (R^2) was 0.7646, 0.6673 and 0.6826 for *palas*, *ber* and *kusum*, respectively indicating that 76.46 per cent, 66.73 per cent and 68.26 per cent variation in total income from lac utilizing above hosts was explained by four variable namely number of host utilized, human labour day, broodlac (seed) inoculated and other inputs (synthetic net bag and pesticide) for untrained lac growers. Coefficient of determination was 0.9172, 0.8268 and 0.8621 for *palas*, *ber* and *kusum*, respectively for trained lac growers. Human labour day and broodlac inoculated showed significant positive effect on output for both untrained and trained lac growers on all the three hosts. In case of lac cultivation on *ber* by trained lac growers, other input also showed significant positive effect on output. Number of host utilized and other inputs showed non significant positive effect on output for both untrained and trained lac growers on all three hosts.

For untrained lac growers elasticity of production for human labour was highest in lac cultivation on *ber* (0.3539) followed by *palas* (0.3538) and *kusum* (0.2979). This implies that 1 per cent increase in human labour day utilized would increase the gross return of 0.3539 per cent in lac cultivation on *ber*, 0.3538 per cent in *palas* and 0.2979 per cent in *kusum*. In case of trained lac growers, elasticity of production for human labour was highest in lac cultivation on *ber* (0.3248) followed by *kusum* (0.2919) and *palas* (0.2819). Elasticity of production for broodlac inoculated was highest in lac cultivation on *kusum* (0.6387) followed by *ber* (0.5890) and *palas* (0.4969) for untrained lac growers while, for trained lac growers it was highest in lac cultivation on *ber* (0.7057) followed by *kusum* (0.6952) and *palas* (0.6647). The elasticity of production for other inputs was 0.2680 for lac cultivation on *ber* for trained lac growers. The positive and less than unit production elasticities of variables (inputs) indicated that

the use of these variables in the rational zone of production surface for both trained and untrained lac growers on all the three hosts. The sum of elasticities showed decreasing return to scale in lac cultivation on *palas* and increasing return to scale in case of *ber* and *kusum* by untrained lac growers while for trained lac growers sum of elasticities showed increasing return to scale in all the three hosts.

The marginal value productivity (MVP) is the marginal return of an input variable in monetary terms and can be defined as the additional return obtained from an additional unit of input. The Marginal value productivity of different inputs for untrained and trained lac growers have been presented in Table 3. The MVP of all the inputs use in lac cultivation for trained lac growers was higher in comparison to untrained lac growers for all the three hosts except use of human labour in *kusum*. The MVP of human labour was highest in case of lac cultivation on *kusum* followed by *ber* and *palas* for both untrained and trained lac growers. The MVP for other input was Rs. 12.7 and Rs. 3.9 for lac cultivation on *kusum* and *palas*, respectively for untrained lac growers and for trained lac growers it was Rs. 13.12, Rs. 17.36 and Rs. 19.22 for lac cultivation on *palas*, *ber* and *kusum*, respectively.

Table 4 shows the adoption percentage of various techniques by untrained and trained lac growers. Significant increase has been found in case of trained lac growers regarding adoption of all improved lac cultivation techniques except *phunki* (used up broodlac) removal (adoption of this technique is already high). Adoption percentage of improved techniques by trained lac growers was 76 per cent for adoption of coupe system, 92 per cent for pruning of lac hosts, 86 per cent for selection of

Table 1: Cost and returns in lac cultivation on different hosts by untrained and trained lac growers (Rs.)

Particulars	Palas (10 host)		Ber (10 host)		Kusum (10 host)	
	Untrained	Trained	Untrained	Trained	Untrained	Trained
Gross return	1490	2340	2889	5775	23165	44171
Cost of cultivation	513	707	935	1592	6881	11042
Net return	977	1634	1954	4183	16281	33129
Input-output ratio (BC ratio)	2.29	3.31	3.09	3.63	3.37	4.0
Family labour income	1127	1785	2250	4582	17552	34389
Farm business income	1133	1802	2256	4599	17583	34473

Table 2 : Production elasticities, standard error and coefficient of determination for lac cultivation on different host by untrained and trained lac growers

Input/ particulars	Palas		Ber		Kusum	
	Untrained	Trained	Untrained	Trained	Untrained	Trained
Number of host utilized	0.1152	0.0166	0.0632	0.1019	0.0614	0.0231
	(0.1121)	(0.0859)	(0.1067)	(0.2047)	(0.1729)	(0.1129)
Human labour day	0.3538*	0.2819*	0.3539*	0.3248*	0.2979*	0.2919*
	(0.1839)	(0.1114)	(0.1361)	(0.1614)	(0.1844)	(0.0690)
Broodlac	0.4969*	0.6647*	0.5890*	0.7057*	0.6387*	0.6952*
	(01020)	(0.1135)	(01389)	(0.1889)	(0.1192)	(0.1333)
Other input	0.0254	0.0973	-	0.2680*	0.0146	0.2123
	(0.0310)	(0.0200)		(0.1102)	(0.0534)	(0.1214)
R^2	0.7646	0.9170	0.6673	0.8268	0.6826	0.8621
Sum of elasticities Σb_i	0.9913	1.0605	1.0061	1.4004	1.0126	1.2225

*Significant at 1 per cent probability level; Figures in parentheses are the standard error

Table 3: Marginal value productivity of different inputs in lac cultivation for untrained and trained lac growers

Input	Palas		Ber		Kusum	
	Untrained	Trained	Untrained	Trained	Untrained	Trained
Human Labour	1.13	1.95	1.25	2.68	4.25	3.45
Broodlac	1.38	3.15	2.45	4.00	1.95	4.55
Other	3.90	13.12	-	17.36	12.7	19.22

The MVP were compared with Rs. 1.00

Table 4 : Adoption of various techniques by untrained and trained lac growers (in percentage)

Techniques	Adoption percentage	
	Untrained lac growers	Trained lac growers
Adoption of coupe system	7.0	76.0*
Pruning of lac host	62.5	92.0*
Selection of good quality Broodlac	28.0	86.0*
Bundling of Broodlac and tagging on plant	42.0	84.0*
Phunki removal	87.5	100.0
Spraying of insecticide	7.0	54.0*
Use of synthetic net	5.0	38.0*
Spray of fungicide	0.0	18.0*

* indicates significance of value at P=0.05

good quality broodlac, 84 per cent for bundling of broodlac and tagging on plant, 100 per cent for *phunki* removal, 54 per cent for spraying of insecticide, 38 per cent for use of synthetic net and 18 per cent for spray of fungicide. Adoption percentage was low in case of spraying of insecticide, use of synthetic net and spray of fungicide by trained lac growers due to unavailability of these inputs in local market. Higher adoption rate of improved lac cultivation practices was found to be contributing significantly towards higher income and employment generation of trained lac growers in comparison to that in case of untrained lac growers.

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