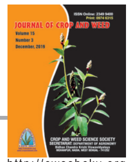
Journal of Crop and Weed, 18(3): 238-244 (2022)
ISSN- O : 2349 9400 ; P : 0974 6315



http://cwssbckv.org
www.cropandweed.com

An economic impact of lac based livelihood on tribal community of West Bengal, India

B. C. MAHATO, S. DE AND *[1]S. CHATTERJEE

Comprehensive scheme for studying the Principal Crops in India,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia- 741252, West Bengal, India
[1]Department of Agricultural Economics, Bidhan Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia- 741252, West Bengal, India

Received : 20.09.2022 ; Revised : 24.09.2022 ; Accepted : 12.10.2022

DOI : https://doi.org/10.22271/09746315.2022.v18.i3.1641

ABSTRACT

The present study tries to focus on the scopes and opportunities to enhance lac based livelihood among small and marginal tribal community of the western part of West Bengal. Output oriented DEA-Malmquist Indices have been framed to assess the technical efficiency level of the lac growers followed by resource use efficiency to judge the optimum utilization of limited resource. The study reveals that lac farming has positive and significant bearing upon the economy of the tribal households. Farming contributes significantly to the livelihood of the forest people. Despite variation in technical efficiency across farmers in lac-farming, the capacity generates for sustainable rural employment irrespective of genders is encouraging. There has been much potential for increase in production through good agricultural practices (GAP) with the available natural resources.

***Keywords*:** Lac growers, data envelopment analysis (DEA), resource use efficiency

Forest is always considered as the primary and cheap source of timber and non-timber products. However, the contribution of forest to overall GDP of our country is around 1.7 %. About 300.0 million tribals and other local people are directly or indirectly depend on forest resources in India. Tribal community, particularly women living in the periphery of forests draw their livelihood fully or partially on minor forest products (MFP) as a source of income. Lac is one of the major non-timber forest products providing employment, income and food security to forest dwellers since time immemorial. Lac is the secretion of small lac insects (*Laccifer lacca*) raised for valuable natural resin, dye and wax. It is produced mainly in South Asian countries such as India, Myanmar, China, Thailand and Indonesia. Lac is a natural commercial culture in forest host trees viz. *Butea monosperma* (palas), *Zizyphus mauritiana* (ber) and *Schleichera oleosa* (kusum) in India (Prasad, *et al.,* 2004, 2006). Its cultivation plays a major role in environmental and ecological stability, socio-economic condition of the people and sub-forest people in India as well as in Asia (Singh and Chatterjee, 1994; Pal, 2009, 2010, 2011; Pal *et al.,* 2009; Pal and Bhattacharya, 2011; Singh *et al*., 2011; Mohammad, 2004; Singh, *et al*., 2011; Jaiswal *et al*., 2011a). India represents world's largest lac-producing country accounting for 80-90% of global production. The states where it is widely grown include Bihar, Madhya Pradesh, West Bengal, Uttar Pradesh, Orissa, Maharashtra and Gujarat. Among them, West Bengal contributes nearly 7.5% of the total lac produced in India. The tribal communities of Chhotonagpur Plateau stretching through Purulia and part of Bankura and West Midnapore districts of West Bengal are largely dependent on lac production. Women have their major contribution towards production of lac in this region (Purohit, 1997). These three districts covering about one third of forest land of West Bengal, represent congenial home for lac production. The focal district of our survey and research has been Purulia, which supplies 80-90% of the state's lac production. The present study envisages the basic need to develop small scale Lac-based industry among tribal people for enhancing overall livelihood of this region (Bharadwaj and Pandey, 1993).

With this above backdrops, the present study aims to focus on the scope and opportunities to enhance lac-based livelihood among small and marginal tribal community of the western part of Bengal. To perform the study, output oriented DEA-Malmquist indices have been framed to assess the technical efficiency level of the lac growers followed by resource use efficiency to judge the optimum utilization of limited resources existing in this region.

MATERIALS AND METHODS

Sampling approach

The current study was conducted in the year 2019-20 in Baghmundi block of Purulia district of West Bengal. The block has the highest forest coverage of about 1,59,000 hectares and it represents highest

Email: soumitra.soum123123@gmail.com

How to cite : Mahato, B.C., De, S. and Chatterjee, S. 2022. An economic impact of lac based livelihood on tribal community of West Bengal India. *J. Crop and Weed*, **18** (3): 238-244.

concentration of lac cultivators. This study was based on primary data collected from 118 lac growing sample households from three villages *viz*, Bandhdih, Gagi and Bukadi. The block and the villages were chosen purposively while sample farmers were selected by simple random sampling methods.

Empirical strategy

The technical efficiency among lac growers were estimated by DEA with output–oriented constant return to scale (CRS) model as developed by Coelli (1996). The technique permits an assessment of the performance or technical efficiency of an existing technology relative to an ideal "best practice" or frontier technology. DEA uses mathematical programming to construct a production frontier comprising a set of linear segments. The frontier relates to the best performance at a point in time and technical efficiency of a DMU (Decision Making Unit) is measured in terms of distance from the frontier.

Analytical model

Data Envelopment Analysis (DEA)

DEA is a linear-programming methodology, which uses data on the input and output quantities of a group of states to construct a piece-wise linear surface over the data points. This frontier surface is constructed by the solution of a sequence of linear programming problems – one for each state in the sample. The degree of technical inefficiency of each state (the distance between the observed data point and the frontier) is produced as a by-product of the frontier construction method.

- The Malmquist TFP Index: Malmquist Productivity index makes use of distance functions to measure productivity change.
- It can be defined using input or output orientated distance functions.
- This approach was first proposed in Caves *et al.*, (1982).
- We just look at the Output-orientated Malquist productivity Index (MPI).
- Using period s-technology:

$$m_o^{s}\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)=\frac{d_o^{s}\left(\mathbf{q}_t,\mathbf{x}_t\right)}{d_o^{s}\left(\mathbf{q}_s,\mathbf{x}_s\right)}$$

- Using period t-technology:

$$m_o^{t}\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)=\frac{d_o^{t}\left(\mathbf{q}_t,\mathbf{x}_t\right)}{d_o^{t}\left(\mathbf{q}_s,\mathbf{x}_s\right)}$$

- Since there are two possible MFP measures, based on period s and period t technology, the MFP is defined as the geometric average of the two:

$$m_o\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)=\left[m_o^{s}\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)\times m_o^{t}\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)\right]^{0.5}$$
$$=\left[\frac{d_o^{s}\left(\mathbf{x}_t,\mathbf{q}_t\right)}{d_o^{s}\left(\mathbf{x}_s,\mathbf{q}_s\right)}\times\frac{d_o^{t}\left(\mathbf{x}_t,\mathbf{q}_t\right)}{d_o^{t}\left(\mathbf{x}_s,\mathbf{q}_s\right)}\right]^{0.5}$$

- It can be decomposed into efficiency change and technical change:

$$m_o\left(\mathbf{q}_s,\mathbf{q}_t,\mathbf{x}_s,\mathbf{x}_t\right)=\underbrace{\frac{d_o^{t}\left(\mathbf{x}_t,\mathbf{q}_t\right)}{d_o^{s}\left(\mathbf{x}_s,\mathbf{q}_s\right)}}_{\text{Efficiency change}}\underbrace{\left[\frac{d_o^{s}\left(\mathbf{x}_t,\mathbf{q}_t\right)}{d_o^{t}\left(\mathbf{x}_t,\mathbf{q}_t\right)}\times\frac{d_o^{s}\left(\mathbf{x}_s,\mathbf{q}_s\right)}{d_o^{t}\left(\mathbf{x}_s,\mathbf{q}_s\right)}\right]^{0.5}}_{\text{Technical change}}$$

Mathematically the problem DEA is expressed as Max φ,λ φ,
Subject to

$$-\varphi y_i + Y\lambda \geq 0,$$
$$x_i - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

In the above mathematical model, φ can take any value between one and infinity. The proportional increase in output that could be achieved by the i^{th} lac producing farm or decision making unit (DMU) with input quantities held constant is indicated by (φ-1). Y is (1 × N) the output matrix, λ is (N×1) vector of intensity variables, X is (K×N) the input matrix, Y1 is the output of i^{th} farm, N1′ is a vector of (N×1) and convexity restriction. The ratio of 1/φ defines a technical efficiency score between zero and one (Coelli, 1996)

To identify and analyze various factors on DMU-specific efficiency score, the following multiple regression model has been used.

$$TE_i=\beta o+\beta_1 X_{1i}+\beta_2 X_{2i}+\beta_3 X_{3i}+\beta_4 X_{4i}+\beta_5 X_{5i}+\beta_6 X_{6i}+\beta_7 X_{7i}+e_{ij}$$

Where:

TE_i refers to Technical Efficiency score of the i^{th} DMU,

X_{1i} indicates volume of the farm of the i^{th} DMU- here volume is measured in terms of production,

X_{2i} indicates gross income of the i^{th} DMU

X_{3i} indicates land-holding of the i^{th} DMU

X_{4i} indicates length of experience of the i^{th} DMU

X_{5i} is a dummy variable indicating level of education of the i^{th} DMU- it takes value 0 when DMU is illiterate, 1 when he is literate.

X_{6i} is a dummy variable indicating social mobility of the concerned DMU. It takes value 1 when DMU becomes socially mobile otherwise it takes the value of zero

X_{7i} indicates scale of operation measured in terms of number of trees handled by the i^{th} DMU

e_{ij} is the disturbance term, having zero mean, a constant variance irrespective of units and e_{ij} is independent for $i \neq j$.

The above regression model was fitted by backward regression technique discarding trivial variables and finally selecting those variables which act as exogenous variables.

RESULTS AND DISCUSSION

Contribution of lac in livelihood

The Table 1 exhibits importance of lac among the sample households in terms of its contribution to their livelihoods. A sizeable portion of households earned one third or more of their gross family income from lac. Specifically, more than fifty percent of households belong to this category. The table also reveals that at least 36% of households obtained 10 to 30 percent gross family income from lac as an additional as well as alternate source of livelihood.

A critical look on Table 2 would show that income from lac shares a large proportion of agricultural income for all the sample growers. The table clearly indicates that eighty two households had an income from lac source which is more than one third of total agricultural income. About 40% farmers had earned more than 50% of farming income from lac. This may explicit that farm income is highly contributed by lac. To add further, about 70% of the sample households earned more than Rs. 10,000 from lac cultivation (Table 3).

Employment

Lac farming is not only a major contributor of livelihood income source of this region, but also a provider of employment in this backward region.

It was estimated that on an average 64 man-days had been created by individual lac-growers irrespective of level of production. The Table 4 depicts that 50% of lac-growers had an opportunity to generate employment ranging from 61to 100 man-days. In addition to employment generative capacity, lac-cultivation absorbs unused or underused family labor (Pal, *et al.,* 2010a). Pattern of family labor use in lac-cultivation is examined from Table-5. Participation of women in lac cultivation is observed from the Table-6. On an average work-participation rate of women has been estimated to be 46.78% of total labor requirements (Purohit, 1997). About 86% of sample households utilized women work-force to the extent of 40 to 70% and above. Thus, in terms of gender equity lac cultivation has much social value. Moreover, lac cultivation enlarges scope for using unutilized women workforce in this region (Table 4 and 5).

Gender neutrality of lac-cultivation is highlighted in Table 6. There are some specific areas of operations in lac cultivation where women are preferred to participate. For example peeling, grading, loading and unloading of lac-materials from the field to home yard are usually carried out by women. In addition, women conserve and grade brood-lac ready for seeding. Table 6 unravels work-participation of women in lac cultivation.

Resource use efficiency

Production technology of lac is simple and does not require any sophisticated technique or exogenous materials. Further, lac cultivation requires less capital and it can be grown in the least fertile land. In the sample area, growers use seed and labor as the major ingredients for lac-production. For lac-farming majority of them usually utilize *palash* as host-plant.

Albeit lac production involves a simple technology but it requires skills and experience of the grower for getting high level of out-turn. Thus, intra-variation in efficiency level is evident across the sample growers.

Mean efficiency score of the sample households has been found to be 0.80 (Table 7). This points out to the concern of lac-potential in the sample areas with the existing level of input uses. In other words, on an average lac-production could be enhanced by about 20% if all the households catch up the existing best practices of lac production and remain on the production frontier. There are a good number of households who were far away from the mean frontier.

Table 1: Classification of lac households according to proportional gross income from lac

Classification (% of household income from lac)	Number of households	Proportion of households (%)	Cumulative households	Cumulative percentage
Upto 10	17	14.4	17	14.4
10-30	43	36.44	60	50.84
30-50	33	27.97	93	78.81
50-70	21	17.8	114	96.61
70 &above	4	3.39	118	100
Total	**118**	**100**		

Table 2: Classification of lac-households according to proportional gross agricultural income from lac

Classification (% of agriculture Income from lac)	Number of households	Proportion of households (%)	Cumulative households	Cumulative percentage
Upto 10	14	11.86	14	11.86
10-30	22	18.65	36	30.51
30-50	35	29.66	71	60.17
50-70	30	25.42	101	85.60
70 &above	17	14.41	118	100
Total	**118**	**100**		

Table 3: Classification of lac-households according to net income from lac

Classification (Net income from lac in Rs.)	Number of households	Percentage of households	Cumulative households	Cumulative percentage
Upto 10,000	35	29.66	35	29.66
10,000-20,000	48	40.68	83	70.34
20000-30,000	21	17.80	104	88.14
30,000-40,000	10	8.47	114	96.61
40,000& above	4	3.39	118	100
Total	**118**	**100**		

Table 4: Distribution of labor-use (man-days) among sample households

Man-days used	Frequency of households	Percentage of households	Cumulative numbers
10-20	8	6.78	8
21-40	21	17.80	29
41-60	15	12.71	44
61-80	28	23.73	72
81-100	31	26.26	103
101-200	13	11.01	116
200 above	2	1.70	118
Total	**118**	**100**	

Table 5: Extent of family labour use by lac growers in sample villages

% of family labour used to total labour	Frequency of households	Proportion of households	Cumulative proportion
20-40	20	16.95	16.95
40-50	38	32.20	49.15
50-70	40	33.99	83.14
70-90	16	13.57	96.71
90-100	4	3.39	100

Table 6: Work participation of women in lac cultivation

Work-participation rate of women (%)	Frequency of household	% of household	Cumulative frequency	Cumulative percentage
20-40	14	11.86	14	11.86
40-50	75	63.56	89	75.42
50-70	28	23.73	117	99.15
70 & above	1	0.85	118	100

Table 7: General description of efficiency scores across DMUs

	N	Range	Min	Max	Mean	S.D
Efficiency Score	118	.40	.60	1.00	.8039	.1009

Table 8: Distribution of sample DMUs according to level of technical efficiency

	Cluster I (super inefficient)	Cluster II (inefficient)	Cluster III (efficient)	Cluster IV (super efficient)
Technical Efficiency	.64	.75	.86	.98
No. DMUs	12	53	38	15

Table 9: Group-wise average inputs used and possibilities of minimization

Group	Input used			Target reduction		
	Tree (No.)	Seeds brood-lac (kg)	Labour (mandays)	Tree (No.)	Seed brood-lac (kg)	Labour (mandays)
Super efficient	68.11	69.39	51.69	0.02	0.02	0.10
Efficient	70.19	71.27	52.53	9.82	1.39	6.00
Inefficient	54.67	56.01	39.49	13.66	14.00	09.87
Super inefficient	38.40	38.66	32.62	13.83	13.91	11.74

The above table shows much scope for minimizing resource without loosing output level.

Table 10: Estimates of regression parameters

Components	Coefficients
No. trees	-0.0017*(0.0001)
Prd. level	0.0003*(0.001)
Experience	0.0097*(0.001)
Efficiency score	0.5240*(0.022)
R Square	0.862
Adjusted R Square	0.858
Std. Error of the Estimate	0.04

N.B.: Figure in parentheses indicate Standard Error of coefficient and *Significant at $p_{0.01}$ level

Regarding extent of intra-variation among the DMUs the technical efficiency score ranged between 0.60 to 1.00, while the sample lac growers were clustered (all the DMUs) in four distinct classes according to their proficiency in technology where inefficient DMUs were featured in highest number with technical efficiency equals to 0.75 followed by efficient classes having technical efficiency level equals to 0.86 indicating high level of efficiency score (Table 8).

Further, it is evident from Table 8 that about 12.7 % of the members under study belonged to the super inefficient group. This means that these members are having less than 36% of production comparing to the super efficient group with the same level of resources, on the other, the inefficient group is the largest group in terms of members. About 45% households fall under this category. The average level of efficiency figure of this group points to the fact that there exists the scope for augmenting at least one fourth of production for all the individual members under this classification. Efficient group comprising about one third of the members have also left the provision for increasing production, at least to the tune of 10% when they would turn to catch up production frontier. Finally, the fourth group featuring the super efficient group is relatively at higher level of adapting technology but number of members is few in this desired category.

Scope for minimizing inputs

This section attempts to show how lac-growers could save their prime inputs for production. The Table 9 shows group-wise inputs that could be saved without sacrificing existing output.

Determinants affect the technical efficiency of resource

It is observed that technical efficiency is linearly dependent on three determinants; *viz.* number of trees (scale of production), size of business (production level) and experience of the lac-grower. The above predictors explain about 86% variation in efficiency level among the DMUs.

Thus the refined form of the regressive model is:

$TE_i = \beta o + \beta_1 X_{1i} + \beta_4 X_{4i} + \beta_7 X_{7i} + e_i$

Among the âs values, length of experience (X_4) have shown contributing relatively highest followed by the production variable (X_1). Number of trees(X_7) has exhibited negative relationship with efficiency level. It may due to excess use of lac host tree. This also indicates that the households who have undertaken many trees for cultivation suffers from diseconomies of scale (Table 10).

CONCLUSION

The entire study concluded that lac farming has positive and significant bearing upon the livelihood of the tribal households in these regions of West Bengal. Lac farming contributes significantly to the livelihood of the forest people. Despite variation in technical efficiency across the lac farmers, the capacity generates for sustainable rural employment irrespective of genders is encouraging. There has been much potential for increase in production through good agricultural practices (GAP) with the available natural resources.

REFERENCES

Bhardwaj, S.P. and Pandey, R.K. 1993. Study of production, trade and policy reform for lac cultivation in India. *Bihar J. Agric. Marketing*, **1**(4): 404-419.

Caves, D., W., Christensen, L, R., Diewert, W. E. 1982. The Economic theory of index numbers and the measurement of input, output and productivity. *Econometrica*, **50**(6): 1393-1414. https://www.jstor.org/stable/1913388

Coelli, T.J. 1996. A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation. CEPA Working Paper No. 7/96, Department of Econometrics, University of New England, Armidale. http://www.uq.edu.au/economics/cepa/frontier.php

Jaiswal, A.K., Pal, G., Singh, J. and Patel, B. 2011a. Growth analysis of lac production for the state of Chhattisgarh. *J. Non Timber Forest Products,* **18**(3): 175-180.

Mohammad, Z. 2004. Community forestry for poverty reduction in Bangladesh. *RAP Publication*, (04): 81-94

Pal, G. 2009. Consumption expenditure pattern of lac growers in Jharkhand. *Env. and Ecol.*, **27**(4): 1495-1497.

Pal, G. 2010. Growth and instability in production and export of Indian lac. *Indian Forester*, **136**(9): 1235-1240.

Pal, G. 2011. Socio-economic characteristics of lac growers in Kanker district of Chhattisgarh. *Indian-Forester.*, **137**(11): 1294-1297.

Pal, G. and Bhattacharya, A. 2011. An analysis of price behaviour of lac at different levels of market in Jharkhand. *J. Non Timber Forest Products*, **18**(4): 261-264.

Pal, G., Bhagat, M.L. and Bhattacharya, A. 2009. Economics and resource use efficiency of lac cultivation in Jharkhand. *Indian J. Forest.*, **32**(1): 95-98.

Pal, G., Jaiswal, A.K. and Bhattacharya, A. 2010a. Estimation of lac production and processing in India. *Env. and Ecol.,* **28**(1B): 572-576.

Prasad, N., Guttulia, S., Panday, S.K. and Bhagat, M.L. 2006. Design and development of power operated roller type lac scraper., *AMA-Agric. Mechanization Asia, Africa and Latin America*, **37**(1): 35-37.

Prasad, N., Kumar, K.K. and Jaiswal, A.K. 2004. Energy requirement in lac production. *AMA-Agric. Mechanization Asia, Africa and Latin America,* **35**(1): 54-58.

Purohit, M. 1997. Employment and income generating MFP species for women: collection, processing and marketing. *Vaniki Sandesh,* **21**(1): 7-13.

Singh, B.P. and Chatterjee, R. 1994. Potential for increasing lac production in West Bengal. *Van Vigyan*, **32**(1/2): 44-47.

Singh, J.P., Jaiswal, A.K. and Monobrullah, M. 2011. Green lacewing (*Chrysoperla zastrowi arabica*) incidence on Indian lac insect (*Kerria lacca*). *Indian J. Agric.Sci.*, **81**(11): 1087-1089.