ECONOMIC ANALYSIS OF BAMBOO CULTIVATION IN NAGALAND

WALOSANGLA AO & B. KILANGLA JAMIR

Department of Economics, Nagaland University, Nagaland, India

ABSTRACT

In recent years, bamboo based sector is gaining commercial importance in Nagaland state. From time immemorial people are closely associated with bamboo, having strong influence on their art, handicrafts and the economy. Yet, it is neither documented properly nor studied systematically. Therefore, the paper is an attempt to understand the factors responsible for effecting the production of bamboo cultivation and profit of the bamboo cultivators in Nagaland. The result of multiple regression analysis indicates that profits, total cost of production and area under cultivation are significant predictors of annual production. Further, number of years in bamboo cultivation and size of plantation are statistically significant and they are significant predictors of annual profit.

KEYWORDS: *Bamboo Cultivation, socio economic, multiple regressions, annual production, profits*

Received: Jan 15, 2021; **Accepted:** Feb 05, 2021; **Published:** Feb 16, 2021; **Paper Id.:** IJECRJUN20211

INTRODUCTION

Bamboo is the common term applied to a broad group of large woody grasses, ranging from 10cm to 40m in height (Scurlock et al., 2000). Bamboo originates from Southeast Asia, where it is a natural component of the forest ecosystem (Dannenmann et al., 2007). There are around 1,500 bamboo species which exist worldwide and most of which grow in Southeast Asia (Wong, 2004). It is estimated that India has the second largest bamboo reserves in the world after China (Panda, 2011). The single-most important item of forest produce used by rural communities of the tropics, from the cradle to the coffin, is the bamboo (Balakrishnan Nair., et al, 1990). The importance of bamboo and its multiple uses have received great interest lately, having considerable economic importance especially in many Asian countries.

Bamboo is an important part of rural livelihood in many countries, especially in developing countries like India. In India, forests have been a major contributor to its economy and play a significant role in providing livelihoods to a number of people. The forests cover spanning up to 68 million hectare, wherein the availability of Non-timber forest products (NTFPs) have also taken a primary position as a source of livelihood for the people. In terms of bamboo production, India is one of the richest providers in the world, second only to China. According to India State of Forest Report (ISFR2019), bamboo grows in about 12.8% of its total forest area (9.57 million hectares). But the country taps only one tenth of its bamboo potential and contributes only 4% of the global market mainly because of low productivity (around .33 tonnes per hectare per annum). The annual bamboo production in the country is estimated at 3.15 million tonnes. Bamboo is thus an important contributor to the local economy in India, with its annual turnover of about 9,000 crores of rupees with an approximate demand of 26 million metric tonnes annually and it is expected to raise in future (Reddy, 2018).

North East region of India is the major bamboo producing area, where forest and its resources have influenced their way of life significantly. Total forest cover in the region is 1,70,541 sq km., which constituted 65.05% of its geographical area (ISFR, 2019). The region shares nearly 28 per cent of the total bamboo area of the country, constitutes around 66 per cent of bamboo resources of the country and 20 per cent of the world (Rai and Chauhan, 1998).

As one of the states in the region, Nagaland has rich biodiversity and home to many species of flora and fauna. The State's total geographical area is 16,579 sq km. with a forest cover of 12,489 sq km., which comprised of 75.33% (FSI, 2019) of total area. According to the ISFR-2019, in Nagaland, 4284 sq.km is bamboo bearing area (constituted 34.30% of its forest area).

STUDY AREA

Nagaland is one of the states in North Eastern region of India, covering an area of 16,579 sq km, which constitutes 0.50 per cent of the geographical area of the country. The State lies between 25°60' N to 27°40' N latitude and 93°20' E to 95°15' E longitudes and is bordered by Arunachal Pradesh in the north, Manipur in the south, Assam in the west and shares the international border in the east with Myanmar. Nagaland has twelve districts, out of which, two districts were selected to represent the State in the present study, viz., Dimapur and Mokokchung. Mokokchung district has a geographical area of 1,615 sq. km with a total population of 194,622 and the density is 121 persons per sq. km. (Census, 2011). Forest occupies about 83.53% (FSI, 2011) of its total area and 6009 hectares were under bamboo cultivation in 2012. Whereas, Dimapur district has a geographical area of 927 sq. km with a population of 378,811 and the density is 409 persons per sq. km. Forest occupies about 51.72% (FSI, 2011) of its total area and 2530 hectares were under bamboo cultivation in 2012 (Statistical handbook, 2013).

OBJECTIVES

- To assess the socio-economic conditions of bamboo cultivators in Nagaland
- To examine the factors responsible for effecting the production of bamboo and profit.

METHODOLOGY

The study is based on primary data, collected through interview and questionnaire methods. A sample survey was conducted covering both rural and urban areas of the two districts of Nagaland, viz. Dimapur and Mokokchung.

The survey covered Dimapur city and Mokokchung town representing urban area. For the rural area, three villages from each district were purposefully selected. Thus, the sample survey included 2 (two) urban centres and 6 (six) villages. From the sample towns, 103 bamboo cultivating households and from rural area similarly 147 households were selected. Thus, the survey included 250 households of bamboo cultivator.

The data were analyzed with multiple regression method using SPSS software.

RESULT AND DISCUSSIONS

SOCIO ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

The independent social variables such as sex, age, marital status, education level, family size, and experiences in the bamboo cultivation have assumed to exhibit some correlation with the production of bamboo. Data on these socio

economic factors of the respondents are presented in the table as follows:

Table 1: Distribution of respondents by socio economic characteristics

Sl. No. 1	Age group (in Years)	Dimapur	Mokokchung	Total
	< 35	16 (11.94)	8 (6.90)	24(9.6)
	35-55	82 (61.19)	60 (51.72)	142 (56.8)
	>55	36 (26.87)	48 (41.38)	84 (33.6)
	Total	134 (100)	116 (100)	250 (100)
2	Educational Level			
	Primary	83(61.94)	79 (68.10)	162 (67.2)
	Secondary	35 (26.12)	24 (20.69)	59 (23.6)
	Graduates & above	16 (11.94)	13 (11.21)	29 (11.6)
	Total	134 (100)	116(100)	250 (100)
3	Family size			
	0-4	3(2.24)	2(1.72)	5 (2)
	4-8	110 (82.09)	105(90.51)	215 (86)
	8-12	21(15.67)	9(7.76)	30 (12)
	Total	134(100)	116(100)	250 (100)
4	Sources of Income			
	Agriculture	77(57.40)	76(65.52)	153(61.2)
	Own business	35(26.12)	19(16.38)	54(21.6)
	Service	22(16.42)	21(18.10)	43 (17.2)
	Total	134(100)	116(100)	250 (100)

Source: Field Survey 2017-18 (Figures in the parentheses represent percentage).

Age Group

In table 1 (sl.no.1), the sample data show that majority of the cultivators (56.8 per cent) are in their middle age between 35 to 55 years, followed by older age group (33.6 per cent) of above 55 years and the least is younger age group (9.6 per cent) who are below 35 years.

Education

Education is not limited to the skills of being able to read and write alone, but it is making a person enable to take more rational decision and respond to changing conditions. In order to assess the knowledge of the respondents and capability of their understanding of the complex situation and decision making that leads to success of the enterprises, education has been used as one of the determining variables. The sample farmers, on the basis of their educational levels, have been classified into three groups namely, primary level, secondary level and graduates and above.

The data in table 1 (sl no. 2) indicates that majority of the farmers have completed only primary level of education (67.2 per cent), which is followed by 23.6 per cent of secondary level and only 11.6 per cent were of graduates and above.

Distribution of Family Size

The distribution of respondents by family size is presented in the table above (sl no 3), on an average, 86 per cent of the farmers have family size of 4-8 people, whereas 12 per cent were with larger family size of 8-12 members and only 2 per cent with smaller size of less than 4 members.

Source of Income

Agriculture is the main source of livelihood as shown in table 1 (sl. no. 4), from where 61 per cent of respondents earn income, 22 per cent from self-employment activities and 17 per cent from services.

Reasons for Cultivation of Bamboo

Meeting household requirements is the main drive for cultivation of bamboo for 52 per cent of the farmers because bamboo is used for variety of purposes such as building material, fencing, utensils, decorative items, bamboo shoot for consumption etc. For 28 per cent of farmers it supplements their household income, while for 20 per cent bamboo production constituted their primary source of income.

Table 2: Reasons for Cultivation of Bamboo

Reasons	Dimapur	Mokokchung	Total
Domestic needs	66(49.26)	61(52.59)	127 (50.8)
Main source of income	34(25.37)	18(15.52)	52(20.8)
Supplement income	34(25.37)	37(31.89)	71(28.4)
Total	134(100)	116(100)	250(100)

Source: Field Survey 2017-18 (Figures in the parentheses represent percentage).

Among the respondents, the most important reason for bamboo cultivation is to meet the domestic needs, which constituted for 49.26 per cent of households in Dimapur and 52.59 per cent of households in Mokokchung districts. In Dimapur district, the reasons as main source of income and of supplementary income constituted 25.37 per cent each. Whereas, in Mokokchung district, bamboo constituted the main source of income for 15.52 per cent of the respondents and for 31.89 per cent it supplements their income.

Experience in Bamboo Cultivation

It is assumed that with years of experience in business comes efficiency in production. Years of experience and productivity are thus assumed to relate directly to each other. The table below presents farmers' years of experience in bamboo cultivation.

Table 3: Experience in Bamboo Cultivation

Sl. No	Number of Years	Dimapur	Mokokchung	Total
1	0-6	6(4.48)	2(1.73)	8(3.2)
2	6-12	81(60.45)	82(70.69)	163(65.2)
3	12-18	38(28.36)	30(25.86)	68(27.2)
4	18-24	9(6.71)	2(1.72)	11(4.4)
	Total	134	116	250(100.00)

Source: Field Survey 2018-18 (Figures in the parentheses represent percentage).

From table 3, it is observed that majority (65 per cent) of the farmers are into bamboo cultivation for shorter period ranging from 6 to 12 years, followed by 27 per cent of farmers with 12 to 18 years of experience. Only 4 per cent have longer years of experience of 18 to 24 years and 3 per cent with very short period of experience of below 6 years.

Regression Analysis

A multiple regression analysis was carried out to see whether the independent variables like area under bamboo cultivation, number of years of experience in cultivation, annual profits and annual total cost are significant predictors of annual production of bamboo. The following regression model is set up to carry out this analysis.

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \varepsilon$$

Where, y = Annual Production (culms)

β_i = Parameter

ε = Error

X_1 = Number of years in bamboo cultivation

X_2 = Area of cultivation (hectare)

X_3 = Total cost per year (Rs.)

X_4 = Profits (Rs)

Table 4.1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.998a	.995	.995	1402.669	1.185

a Predictors: (Constant), Profit, area of cultivation, Number of years in cultivation, Total cost

b Dependent Variable: Annual production

The correlation coefficient R is 0.998, seems to indicate close relationship of the variables (dependent and predictors). The coefficient of determination R^2 is 0.995, thus, about 99.50% of the variation in production is explained by area of cultivation, number of years in cultivation, total cost and profits. The regression analysis seems to be appropriate for making useful predictions since the value of R Square is close to 1. The Durbin-Watson $d=1.185$, which is between two critical values of $1.5 < d < 2.5$. Therefore, we can assume that there is no first order linear auto-correlation in our multiple linear regression data.

Table 4.2: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	9.679	4	2.420	1.230	.000 ^a
Residual	4.820	245	1967480.46		
Total	9.727	249			

The table shows that the independent variables significantly predicts the dependent variable, $F(4, 245) = 1.230$, $p < .001$. From the data analysis, we can infer that the F-test is highly significant. This indicates that the model explains a significant amount of the variance in production.

Table 4.3: Correlations

	Particulars	Total production annually	Number of years in cultivation	Area	total cost	Profit
1. Pearson Correlation	Total production annually	1.000	.515	.624	.954	.971
	Number of years in cultivation	.515	1.000	.039	.353	.581
	Area	.624	.039	1.000	.810	.487
	Total cost	.954	.353	.810	1.000	.871
	Profit	.971	.581	.487	.871	1.000
2. Sig. (1-tailed)	Total production annually	.	.000	.000	.000	.000
	Number of years in cultivation	.000	.	.271	.000	.000
	Area	.000	.271	.	.000	.000
	total cost	.000	.000	.000	.	.000
	Profit	.000	.000	.000	.000	.

Pearson product-moment correlation statistics were computed for the predictor variables on data for $N=250$ cultivators. Correlation analyses were used to examine the relationship between number of years in cultivation, area of cultivation, total cost and profit. The first row shows the correlation coefficient ('r') while the second row shows their statistical significance. Results indicate the relationship as statistically significant at $p < .001$. Further, the data also show positive relationship between the outcome variable and predictors. There exist positive relationship between production and number of years in cultivation, area of cultivation, total cost and profits, where $r = .515$ ($p < .001$), $r = .624$ ($p < .001$), $r = .954$ ($p < .001$) and $r = .971$ ($p < .001$), respectively.

Table 4.4: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	608.112	366.737		1.658	.099
	Number of years in cultivation	88.157	35.387	.015	2.491	.013
	Area	1113.172	93.382	.145	11.921	.000
	Total cost	.282	.009	.692	33.129	.000
	Profit	.122	.004	.430	29.485	.000

a. Dependent Variable: Total production annually

A multiple regression analysis was conducted to test whether the predictors like total cost, profits, area of cultivation and number of years in cultivation could significantly predict the outcome variable i.e. annual production. The

above regression coefficient table 4.4 provides the significance level, beta coefficient and the t-values. The results indicate that area, total cost and profits are statistically significant at $p < .001$ level. The results of the regression indicated that the model explained 99% of the variance and that the model was a significant predictor of annual production, $F(4, 245) = 1.230$, $p < .001$. The result of analysis reveals that profits, total cost and area of cultivation are significant predictors of annual production.

The area under bamboo cultivation ($B = .145$, $p = .000$) is significant and its coefficient is positive indicating that predicted annual production increases by 14.5% for each 1 percent increase in area. Total cost ($B = .692$, $p = .000$) is significant and predicted annual production increases by 69.2% for each 1 percent increase in total cost. Profit ($B = .430$, $p = .000$) is significant and predicted annual production increases by 43% for each 1 percent increase in profit.

2. Regression Analysis of Socio Economic Factors on Profit

Another multiple regressions analysis is carried out to investigate whether the independent variables such as age, marital status, educational qualification, family size, main source of income, motive and number of years of cultivation could significantly predict the annual profit from bamboo cultivation.

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \beta_6x_6 + \beta_7x_7 + \epsilon$$

Where, y = Dependent variable

β_i = Parameter

ϵ = Error

x_1 = Age

x_2 = Marital status

x_3 = Educational qualification

x_4 = Family size

x_5 = size of plantation

x_6 = motive

x_7 = Number of years in cultivation

Table 5.1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.641 ^a	.411	.394	54424.419	1.504
a. Predictors: (Constant), Number of years in cultivation, Marital, size of plantation, motive, Educational qualification, family size, age					
b. Dependent Variable: Profit					

The correlation coefficient R , which measures the quality of the prediction of the dependent variable where $R =$

0.641, seems to indicate a good level of prediction. The coefficient of determination, $R^2 = 0.441$, thus, about 45% of the variation in profit is explained by Number of years in cultivation and size of plantation. The regression analysis seems to be appropriate for making useful predictions since the value of R Square is close to 1. The Durbin-Watson $d=1.504$, which is between two critical values of $1.5 < d < 2.5$. Therefore, we can assume that there is no first order linear auto-correlation in our multiple linear regression data.

Table 5.2: ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.994E11	7	7.134E10	24.086	.000 ^a
	Residual	7.168E11	242	2.962E9		
	Total	1.216E12	249			

The regression's F-test has the null hypothesis that the model explains zero variance in the dependent variable ($R^2 = 0$). The table shows that the independent variables significantly predicts the dependent variable, $F(7, 242) = 24.086$, $p < .001$. From the data analysis, we can infer that the F-test is highly significant. This indicates that the model explains a significant amount of the variance in profit.

Table 5.3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-58004.163	27835.651		-2.084	.038
	Age (in years)	-724.785	478.241	-.095	-1.516	.131
	Marital status	-4979.232	7501.496	-.033	-.664	.507
	Educational level	-5658.009	5371.359	-.056	-1.053	.293
	Family size	661.858	2638.305	.014	.251	.802
	Size of plantation	20986.937	4718.106	.231	4.448*	.000
	Motive	5341.456	4138.947	.066	1.291	.198
	Number of years in cultivation	12500.651	1148.119	.620	10.888*	.000

a. Dependent Variable: Profit

*Significant at 1% level

A multiple regression analysis was conducted to test whether the predictors like age, marital status, educational qualifications, family size, size of plantation, motives and number of years in cultivation could significantly predict the outcome variable i.e. profit from bamboo cultivation.

The coefficient table provides us with the significance level the t-values, and beta coefficient. The results indicate that bamboo cultivation as main source of income and Number of years in cultivation are statistically significant at $p < .001$ level and positive. The data reveals that number of years in bamboo cultivation and size of plantation are significant predictors of profits. The experience in bamboo cultivation matters as it can be seen from the above table. The number of years in cultivation ($B = .620$, $p = .000$) is significant and its coefficient is positive indicating that predicted value of profit increases by 62% for 1 percent increase in years of cultivation. The size of plantation ($B = .231$, $p = .000$) is significant and

its coefficient is positive indicating that predicted value of profit increases by 23.1% for 1 percent variation in size of plantation. Thus we can deduce that higher the size of cultivation the more will be the efficiency.

CONCLUSIONS

The socio-economic characteristics of the bamboo cultivators in the study indicates that almost 57 per cent of the cultivators are of middle aged group ranging between 35-55 years having a positive bearing on bamboo cultivation. However, majority of the cultivators (68 per cent) are with low level of education (only up to primary level). Moreover, 80 per cent of the cultivators have somewhat larger family size (of 4-8 people), and agriculture is the main source of income.

Multiple regression analysis reveals that the predictors like area of cultivation, number of years of cultivation, profits and total cost are significant predictors of total annual production of bamboo, which are positively related. Since, the increase in area of cultivation and investment (cost) results in higher production, thus the vast degraded land area of 2496 hectare (GoN, 2015) and other uncultivable areas in the State may be brought under managed bamboo cultivation, with increased investment and thus create a sustainable resource base. Bamboo plantation for productive and protective utilization of uncultivable land is not only profitable for the local stakeholders but also an economically viable policy option for the funding agencies and government as it will generate additional employment and income that sustain and secured the livelihood of the people.

REFERENCES

1. Dannenmann, B. M., Choocharoen, C., Spreer, W., Nagle, M., Leis, H., Neef, A., & Mueller, J. (2007, October). *The potential of bamboo as a source of renewable energy in northern Laos. In Conference on International Agricultural Research for Development, University of Kassel-Witzenhausen and University of Gottingen.*
2. Rumandla Sandeep Kumar, K. V. S. Rami Reddy & M. N. K. R. Gurudatt , “Performance Evaluation of Power Weeder in Sandy Soils and Development of Weed Rake “, *International Journal of Agricultural Science and Research (IJASR)*, Vol.7, Issue 5, pp. 433-442
3. Forest Survey of India. (2019). *India State of Forest Report, 2019. Published by the Ministry of Environment and Forests, Government of India* retrieved 12th October 2020 from http://www.fsi.org.in/sfr_2020.
4. Government of Nagaland (2015), *Statistical Handbook of Nagaland, Directorate of Economics & Statistics, Kohima, Nagaland*
5. G. Malarvizhi , “Development of Herbal Finished Baby Diapers with Bamboo Fiber “, *BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS)*, Vol. 3, Issue 2, pp. 41-46
6. Mathew, G., & Nair, K. S. S. (1990). *Storage pests of bamboos in Kerala. In Bamboos. Current research. Proceedings of the International Bamboo Workshop, Cochin, India, 14-18 Nov. 1988. (pp. 212-214). Kerala Forest Research Institute.*
7. Panda H., (2011). *Bamboo Plantation and Utilization. Handbook, Publisher: Asia Pacific Business Press Inc.*
8. Rai, S. N., & Chauhan, K. V. S. (1998). *Distribution and growing stock of bamboos in India. Indian Forester, 124(2), 89-98.*
9. Reddy, Jagdish (2018). *Bamboo Farming Project Report, Cost and Profit Details*, <http://www.https://www.agrifarming.in/bamboo-farming-project-report-cost-profit> (accessed on 24.11.2020)
10. Padma Alapati & Khateerja Sulthana Shaik , “Sisal Fiber - Diversified Approach for Income Generation “, *International Journal of Educational Science and Research (IJESR)*, Vol. 8, Issue 6, pp. 29-34

11. Amrit Paul & Sanjeeb K Jena , “Viability and Prospects of MUGA Silk Cultivation in the Lakhimpur District of Assam “, *International Journal of Business and General Management (IJBGM)*, Vol. 6, Issue 4, pp. 33-44
12. Scurlock, J. M., Dayton, D. C., & Hames, B. (2000). *Bamboo: an overlooked biomass resource? Biomass and bioenergy*, 19(4), 229-244.
13. Wong, K. M. (2004). *Bamboo the amazing grass: a guide to the diversity and study of bamboos in Southeast Asia*.