Economic Affairs, Vol. 64, No. 2, pp. 351-360, June 2019
DOI: 10.30954/0424-2513.2.2019.10

Production Efficiency of Wet Rice and Wet Terrace Cultivation in Nagaland: Some Field Based Evidences

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ABSTRACT

Analysis of production efficiency of rice cultivation of Wet Rice Cultivation (WRC) in Dimapur and Wet Terrace Cultivation (WTC) in Phek district of the state of Nagaland revealed that, WRC under Dimapur district experienced the highest productivity than WTC under Phek district. The reason for higher productivity for WRC when compared to WTC is due to the better use of seeds, fertilizer, machines, and availability of irrigation facility which had a great impact on production and productivity. Both the farming systems in the two districts are labour intensive and the average labour absorption per acre in Phek district is 41.57 labour man days whereas, in Dimapur district it is about 43.9 labour man days. Result from Cobb-Douglas production function shows that capital plays the predominant role in production in both the districts. The study is based on primary data and the data was collected from 300 household from the two districts and three villages each district using a pre-tested interview schedule. The period of the study was the crop year of 2016-17. The study was found that the cost of production is high in case of small and medium farmers, while the profit rate was high for marginal farmers showing inverse relation between farm size and profitability.

Highlights

- Purposive sample technique
- WTC under Phek and WRC under Dimapur district
- Sample size- 150 household each
- Comparative analysis
- WRC is more profitable compared to WTC

Keywords: Wet Terrace & Wet Rice Cultivation, Production function and Efficiency

Agriculture plays an essential role in the process of economic development of a country or a region and also provides food, generates employment, contributes to market of industrial goods and earns income. Agriculture production in India can be increased by a rapid and mass development only by breaking through the state of art and introducing modern technology in a package, consisting of new inputs, agricultural education, special skills, technique and competent guidance in farm planning (Venkatareddy Chennareddy, 1967). Agricultural strategy for raising productivity must be technical change, that is both seed and complementary farm inputs and resources based rather than only seed or only resource-based (Bhupat M. Desai *et al*. 1999).

Agriculture is a dominant activity in Nagaland both in terms of output and employment. In spite of certain favourable conditions prevailing in the state for a prosperous agriculture, productivity of major crops has remained at a low level. The state is an agrarian economy with over 70% of the population depending on it. Rice is the dominant crop and also the staple diet of the people. Out of the 2,60,000 ha of gross cropped area under food grains, rice accounts for about 84.4%. The productivity of rice per acre in is the state is very low, while the cost of production is very high. Cost escalation is the most important factor, which makes rice cultivation

a relatively less remunerative enterprise and it suggested that mechanization should be adopted wherever possible, which will reduce the labour cost (Mohandas and Thomas, 1997).

There are three methods of cultivation predominantly in Nagaland, i,e, jhuming and Wet terrace and Wet Rice cultivation. The area under jhum cultivation is about 87.339 hectares and under terraced cultivation is about 62,091 hectares. Jhum cultivation is practiced in all parts of Nagaland, while Wet rice cultivation is confined to the plain areas of Dimapur district, and Wet terrace cultivation is confined to Kohima and Phek districts. Rice production in the state is constrained by bio-physical, economic and technological bottlenecks. Increasing farm size and technology has substantial benefits for efficiency improvement in cultivation of rice and other regional factors were also found to be important in influencing production efficiency (Linh H. Vu, 1994).

Young generation has better ability to adopt modern technology, when compared to old farmers who are technically inefficient therefore, young generation should be motivated to participate in agricultural related activities and to make timely decisions (Abedullah *et al.* 2007). Suggest the benefits of indigenous practice of Zabo and Alder rice farming system by Naga farmers which is soil and water conserving oriented and is sustainable in the long run(Longshibeni N Kithan, 2014).

Despite of all these obstacles, the farmers have significantly moved on to adopt system such as integrated approaches, organic, dry land farming and double cropping system (Rukuosietuo Kuotsuo *et al.* 2014). A shift from jhum to scientific and ecologically less harmful forms of cultivation like settled cultivation sound to be more profitable but it is doubtful whether settled cultivation can sustain jhum cultivators looking at the context of the uneconomic size of holdings and agricultural stagnation characteristic of eastern India (K.N. Ninan, 1992).

The study will help us to find out the differences in cost of production and productivity among different farming systems, its technical and economic efficiency and factors that promotes as well as hinders production efficiency among different rice farming villages.

Review of Literature

Venkatareddy Chennareddy (1967)a rapid and mass development in agriculture production in India can be increased only by breaking through the state of art and introducing modern technology. Similarly,Singh and Nareshkumar (1998) observed that the main reason for efficiency was due to timely transplanting and application of irrigation, fertilizers and pesticides in appropriate dosages and there was a considerable variation in efficiency across regions and size categories. Whereas,Linh H. Vu (1994) states that increasing land holding and farm size has substantial benefits for efficiency improvement in cultivation of rice and regional factors were also found to be important in influencing technical efficiency

Abedullah *et al.* (2007) old farmers are technically inefficient and therefore, young generation needs to be motivated to participate in agricultural related activities because young generation has better ability to adopt modern technology and to make timely decisions. Rukuosietuo Kuotsuo *et al.* (2014) scientific systems of organic rice cultivation should be taught to the farmers that can give a better option to generate income in a land where fertilizers have never been used before. Longshibeni N Kithan (2014) suggest the benefits of indigenous practice of Zabo and Alder rice farming system by Naga farmers which is soil and water conserving oriented and is sustainable in the long run.

Data and Methodology

For the analysis, primary data was used and data was collected during the year 2016-17. All together 300 household from two districts were selected through interview method. Dimapur district for WRC and Phek district for WTC was selected purposively since these two districts have the largest area, production and productivity under WRC/WTC in Nagaland. A pre-tested comprehensive interview schedule was designed for the canvass in the study area. The data has been analyzed using appropriate statistical tools and technique, such as ratios, percentages, proportions. In addition to the above usual statistical measures Cobb Douglas production function and stochastic production frontier models are applied.

Model

The multiple regression model may be specified as,

$$Y_t = \sum_{i=0}^{k} \beta_i \, X_{it} + \mu_t$$

Where, Y_t is the dependent variable, the X's are the independent variables, and μ_t is the error term. β_1 is the constant term, or intercept of the equation.

Cobb-Douglas production Function is,

$$\ln Y_i = \beta 0 + \sum_{k=1}^{n} \beta_k \ln x_k + v_i - u_i$$

Where, Y_i is the output, β is constant, k is the quantity of capital, v_i and u_i are the error terms.

Production and Productivity Distribution

Table 1 and 2 shows that the distribution production and productivity of rice under different farm size groups in selected districts. Out of 150 households selected from the three villages in Dimapur district, small farmers constitute the largest with a total of 65 (43.335) household, and large farmers are the least with 13(8.66%) household.

Table 1: Yield under WRC in the three selected under Dimapur district (Y=Yield/Acre)

Farm Size	SINGRIJAN		NIHOTO		NIHOKHU	
	Yield In Kg	Bags	Yield in Kg	Bags	Yield in Kg	Bags
MF	1598.48	21.31	1567.02	20.89	1541.02	20.54
SF	1579.5	21.06	1575.34	21.00	1652.3	22.03
MDF	1600.04	21.33	1558.83	20.78	1372.28	18.29
LF	1515.8	20.2	1481.09	19.74	1101.23	14.68
ALL	1573.45	20.97	1545.57	20.60	1416.61	18.88

Source: Field survey 2016-17; Note: MF=Marginal farmer, SF=Small farmer, MDF=Medium farmer, LF=Large farmer; Bag is measured as per the standard measurement set by Govt. of India, i.e., 75 Kg per bag.

Singrijan village gets the highest yield per acre of 1573.45 Kg/Acre or 20.97 bags among the three villages and medium farmers with a total of 11 household get the maximum yield per acre of 1600.04 Kg/Acre or 21.33 bags, which is much higher than the average yield of the village. While large farmers are the one with lowest yield per acre of only 1515.8 Kg/Acre. In Nihoto village, small farmers with a total of 19 household gets the maximum yield per acre of 1575.34 Kg/Acre or 21 bags. Whereas large farmers with a total of 6 household gets a yield of only 1481.09 Kg/Acre or 19.74 bags which is the lowest yield per acre in the village. Even in Nihokhu village yield per acre is maximum for small farmers with a total of 18 household getting an average yield of 1652.3 Kg/Acre. Whereas large farmers with the least household of 6 gets a yield of 1101.23 Kg/Acre or 14.68 bags which is below the average yield of the village of 1416.61 Kg/Acre.

Table 2: Yield under WTC in the three selected villages under Phek district (Y=Yield/Acre)

Farm Size	KIKRUMA		CHIZAMI		PFUTSEROMI	
	Yield in Kg	Bags	Yield in Kg	Bags	Yield in Kg	Bags
MF	1218.49	16.24	1254.89	16.73	1183	15.77
SF	1088.49	14.51	1221.74	16.28	1229.8	16.39
MDF	1219.14	16.25	1229.02	16.38	1175.85	15.67
LF	1259.44	16.79	1246.44	16.61	1222	16.29
ALL	1196.39	15.95	1237.99	16.50	1196.13	15.94

Source: Field survey 2016-17; MF=Marginal farmer, SF=Small farmer, MDF=Medium farmer, LF=Large farmer; Note: Bag is measured as per the standard measurement set by Govt. of India, i,e, 75 Kg per bag.

Similarly, in Phek district medium farmers constitute the maximum number with a total of 62 (41.33%) whereas, large farmers is only 8 (5.33%) households. Chizami village gives the highest yield among the three villages and gets a yield of 1237.99 Kg/Acre or 16.50 bags. In Kikruma village large farmers produces an average of 1259.44 Kg/Acre which is the highest among all the farm size groups in the village followed by medium farmers 1219.14 Kg/Acre and small farmers 1088.49 Kg/Acre. On contrary to that in Chizami village marginal farmers yield highest with an average about 1254.89 Kg/Acre, while small farmers yields lowest about 1221.74 Kg/Acre Whereas in Pfutseromi village, small farmers yields highest among the four farm size with a yield of 1229.8 Kg/Acre and medium farmers are the ones that gets the lowest yield with an average yield of 1175.85 Kg/Acre[1].

[1]Price per bag is sold at different price by different farmers depending on the price the wholesaler is willing to buy but the actual market price is ₹1200 per bag and the measurement is done based on this

Cost of Cultivation

The use of input pattern of rice cultivation by both the farming system is given in the table 3 and 4. The data indicates that farmers under WRC in Dimapur district use more inputs than their counterparts in Phek district. The use of inputs varies among different farm size and also among different villages. Nihokhu village incurs the highest input cost among the three villages. The use of fertilizers and pesticides, farm yard manures are maximum in Singrijan village with an average of ₹ 739.25 and ₹ 1356.71 per acre. On the other hand, the use of bullock labour and transport is maximum in Nihokhu village with an average of ₹ 313.80 and ₹ 312.35 respectively and the reason is that most of this input are purchased at higher prices. In case of labour cost it is more predominate than other input cost and in Nihokhu village incurs the highest cost than their counterpart villages spending an amount of ₹ 9863.71 per acre.

Whereas, in Phek district rice farming is mostly in organic farming practices, so the use of fertilizer is totally absent and even the use of pesticides is also very less. Since, it is very much labour intensive the use of inputs apart from labour input is very low among the villages and different farm size. Use

Table 3: Cost of cultivation in WRC under Dimapur district

Singrijan Village

Particulars	Marginal Farmers	Small farmers	Medium Farmers	Large Farmer	ALL
Seeds (₹)	300	300	300	300	300
Fertilizers (₹)	728	743	735	750	739
Farm Yard Manures ₹)	1260	1371	1445	1350	1356
Machine labour (₹)	2180	2132	1572	1800	1921
Bullock labour (₹)	124	128	130.9	120	126
Transportation	0	0	0	0	0
Human labour (₹)	9,355	9,873	10,345	9,450	9756
Nihoto Village					
Seeds (₹)	300	300	300	300	300
Fertilizers (₹)	655	707	763.5	763	722
Farm Yard Manures (₹)	1,260	1,371	1,445	1,350	1356
Machine labour (₹)	1923	1889	2112	1400	1831
Bullock labour (₹)	124	128	131	120	126
Transportation	333	354	250	312	312
Human labour (₹)	9,355	9,873	10,345	9,450	9756
Nihokhu Village					
Seeds (₹)	300	300	300	300	300
Fertilizers (₹)	692	711	700	730	708
Farm Yard Manures (₹)	950	1025	1304	1350	1157
Machine labour (₹)	2033.33	2044	2126	1900	2026
Bullock labour (₹)	283.33	336	319	317	314
Transportation	190	202	207	190	197
Human labour (₹)	9799.96	9789	9900	9966	9864
Dimapur					
Seeds (₹)	300	300	300	300	300
Fertilizers (₹)	541.81	720.46	733.07	747.77	685.77
Farm Yard Manures (₹)	1156.66	1255.94	1398.41	1350	1290.25
Machine labour (₹)	2045.46	2022.01	1936.86	1700	1926.08
Bullock labour (₹)	177.11	197.51	193.64	185.55	188.45
Transportation	261.66	278.1	228.75	251.25	254.94
Human labour (₹)	9503.32	9845.22	10196.93	9622.21	9791.92

Source: Field Survey 2016-17.

of bullock labour, machine labour and farm yard manures is highest in Chizami village than other counterpart villages, with an average cost ₹ 512.5, ₹ 1830.27 and ₹ 975 respectively. Whereas the use of inputs, like farm yard manures, bullock labour etc. is lowest in Pfutseromi village. Among all three selected villages in Phek district, Pfutseromi village incurs the highest labour cost spending about ₹ 13,489.39 per acre during the study period of 2016-17.

Average Cost, Average Revenue and Profit/Loss

Result from table 5 shows that Nihoto village incurs the lowest cost of production with an average of ₹ 13,692.41, and also earns the highest profit per acre, while Nihokhu village incurs the highest cost with an average cost of ₹ 14,198.74 and earns the lowest profit per acre among the three villages under Dimapur district. The distribution among the farm size groups, the marginal farmers in Singrijan village receive more profit than their counterparts at an average profit of ₹ 11,625, indicating that small farm size is more economical to put more effort to yield higher returns than medium and large farm size groups in Nagaland in which limited scope for adoption of advance technology and other psychological factors are practicing at significant level. Similarly, in Nihoto village marginal farmers are doing better than the rest of the farms size, indicating maximum utilization of labour efficiency.

Similarly, Nihokhu village the efficiency of small farmers is found to be higher than other farm groups. It incurs an average cost of ₹ 14,391.95 per acre which is one of the lowest costs among the farm size in the village and earns an average revenue of ₹ 26,436, making a profit of ₹ 11,877.37. Large

Table 4: Cost of cultivation in WRC under Phek district

Chizami Village

Particulars	Marginal Farmers	Small farmers	Medium Farmers	Large Farmer	ALL
Seeds (₹)	300	300	300	300	300
Pesticides (₹)	100	100	100	100	100
Farm Yard Manures (₹)	825	900	975	1,200	975
Machine labour (₹)	1875	1824	2047	1575	1830.28
Bullock labour (₹)	550	500	600	400	512.5
Human labour (₹)	12,690	12,930	12,677	12,825	12780
Kikruma Village					
Seeds (₹)	300	300	300	300	300
Pesticides (₹)	100	100	100	100	100
Farm Yard Manures (₹)	600	900	1,050	1,200	937.5
Machine labour (₹)	2119.22	1740	1710.53	1725	1823.68
Bullock labour (₹)	0	240	462.5	450	384.16
Human labour (₹)	12,869	12,960	12,640	13,062.5	12883
Pfutseromi Village					
Seeds (₹)	300	300	300	300	300
Pesticides (₹)	100	100	100	100	100
Farm Yard Manures (₹)	0	930	1,028.57	900	952.85
Machine labour (₹)	1858.33	1691.66	1791.17	1100	1610.29
Bullock labour (₹)	0	560	392.85	450	467.61
Human labour (₹)	14,287	13,180	13,139	13,350	13489
Phek					
Seeds (₹)	300	300	300	300	300
Pesticides (₹)	100	100	100	100	100
Farm Yard Manures (₹)	712.5	910	1017.85	1100	935.08
Machine labour (₹)	1950.85	1751.94	1849.55	1466.66	1754.75
Bullock labour (₹)	550	433.33	485.11	433.33	475.44
Human labour (₹)	13282	13023	12819	13079	13051

Source: Field Survey 2016-17.

farmers on the other hand are the ones that gets the lowest profit with an average about ₹ 2,740. Small farmers are found to be receive more profit of ₹ 11,167.96 though the cost of production is found to be the highest of ₹ 14,468.04 per acre. The study depicts that the overall cost of production in Dimapur District, is about ₹ 14,270.52 with an average revenue of ₹ 24,136 and a profit of ₹ 9,864.48 as per table 5. The study reveals that marginal farmers obtains better returns than their counterparts while, small farmers stands higher cost of production per acre in selected villages.

Table 5: Average Cost, Average Revenue and Average Profit/Loss of WRC in the three selected villages under Dimapur district (in ₹)

FARM TYPE	SINGRIJAN VILLAGE		
	AVG COST	AVG REVENUE	PROFIT & LOSS
Marginal Farmer	13,947	25,572	11,625
Small Farmer	14,548.74	25,272	10,723.26
Medium Farmer	14,529.21	25,596	11,066.79
Large Farmer	13,770	24,240	10,470.00
ALL	14,198.74	25,170	10,971.26
NIHOTO VILLAGE			
Marginal Farmer	13,673.09	25,068	11,394.91
Small Farmer	14,000.79	25,200	11,199.21
Medium Farmer	13,714.3	24,936	11,221.70
Large Farmer	13,279.96	23,688	10,408.04
ALL	13,692.41	24,720	11,027.59
NIHOKHU VILLAGE			
Marginal Farmer	14,391.95	24,648	10,256.05
Small Farmer	14,558.63	26,436	11,877.37
Medium Farmer	14,919.77	21,948	7,028.23
Large Farmer	14,875.79	17,616	2,740.21
ALL	14,686.39	22,656	7,969.61
DIMAPUR			
Marginal Farmer	14,091.19	25,096	11,004.81
Small Farmer	14,468.04	25,636	11,167.96
Medium Farmer	14,463.97	24,160	9,696.03
Large Farmer	14,058.96	21,848	7,789.04
ALL	14,270.52	24,185	9,914.48

Source: Field survey 2016-17.

Similarly, in Phek district (Table 6), Pufetseromi village incurs the highest cost of production with an average cost of ₹ 16,565.02 and earn the lowest profit with an average of ₹ 2,424.55. While in Kikruma village the average cost is about ₹ 16,332.5 and earns a profit of ₹ 2,834.47. On the other hand, Chizami village earns the highest profit among all the three villages with an average profit of ₹ 3,335.94 per acre. Among the farm size groups, in Chizami village marginal farmers incurs the minimum cost of production of ₹ 16,339.97 earns the uppermost profit with an average of ₹ 20,076 and ₹ 3,836.03 respectively. The large farmers on the other hand, earn the second highest cost and profit. The data indicates that marginal farmers more efficient than large farm size groups for their intensive farm operations and effective efforts makes more profitable than their counterpart farmers in all the selected villages. Though the Large farmers are getting the highest revenue but due to the higher cost of production when compared to marginal farmers its profit margin is lower. In Pfutseromi village large farmers incurs the lowest cost of production and also earns the highest profit with an average of ₹ 16,200 and ₹ 3,548 respectively.

Table 6: Distribution of Average Cost, Average Revenue and Average Profit/Loss in Phek (in ₹)

FARM TYPE	CHIZAMI VILLAGE		
	AVG COST	AVG REVENUE	PROFIT & LOSS
Marginal Farmer	16,339.97	20,076	3,836.03
Small Farmer	16,554.13	19,536	3,081.87
Medium Farmer	16,699.68	19,656	3,056.32
Large Farmer	16,400	19,932	3,632.00
ALL	16,498.24	19,800	3,335.94
KIKRUMA VILLAGE			
Marginal Farmer	15,989.19	19,488	3,598.81
Small Farmer	16,240	17,412	1,272.00
Medium Farmer	16,263.47	19,500	3,336.53
Large Farmer	16,837.5	20,140	3,402.5
ALL	16,332.5	19,140	2,834.47
PFUTSEROMI VILLAGE			
Marginal Farmer	16,545.83	18,924	2,490.67
Small Farmer	16,761.91	19,668	3,043.59
Medium Farmer	16,752.56	18,804	2,261.01
Large Farmer	16,200	19548	3,548
ALL	16,565.02	19,128	2,424.55
PHEK			
Marginal Farmer	16,358.3	19,496.00	3,308.50
Small Farmer	16,676.77	18,872.00	2,465.82
Medium Farmer	16,665.21	19,320.00	2,884.62
Large Farmer	16,545.81	19,873.33	3,527.5
ALL	16,561.47	19,356.00	2,864.98

Source: Field survey 2016-17.

The study reveals that marginal and large farmers have the highest allocative and technical efficiency among farm size groups. Large farmers make the highest profit in Phek district with an average profit of ₹ 3,527.5, followed by marginal farmers ₹ 3308.50. The average cost of production under Phek district is ₹ 16,561.47 per acre and its average revenue is ₹ 19,356 and they obtain profit on an average of ₹ 2,864.98. The data shows that small farmers incurs the highest cost on production with an average of ₹ 16,676.77 and large farmers earn the highest revenue with an average of ₹ 19,873.33 per acre. But on an overall the highest profit is made by marginal farmers with an average of ₹ 3,308.50 than their counterpart of small and medium farmers.

Factor Determinants: Regression Analysis

Model Specification

$$Y= \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \mu$$

Where,

Y= Output in (₹) (Total production multiplied by price), α= Constant, X_1= Farm Size (₹), X_2= Household Age (Years), X_3= Household Education (Literate= 0, Illiterate= 1), X_4= Family Income (₹), X_5= Household Assets (₹), X_6= Cost on Pesticides (₹), X_7= Seed Cost (₹), X_8= Fertilizer Cost (₹), X_9= Manure Cost (₹), X_{10}= Indebtedness (₹), X_{11}= Technological (₹), X_{12}= Labour Cost (₹), μ Error Term.

Table 7 shows the regression analysis of selected villages in Dimapur district and it indicates that all the variables are showing expected signs except seed cost in Singrijan village. The explanatory variables in Singrijan village shows that the coefficient of farm size is statistically significant at 1 percent level and it indicates that for every 1 percent increase in farm size leads to an increase in productivity by 0.095 times.

Similarly, the coefficient of educational level of, family income, and technological cost shows a positive and statistically significant at 5 percent level. On contrary to that, the coefficient of fertilizer cost shows a negative and statistically significant at 5 percent level. While the other variables such as manure cost, indebtedness and labour cost shows a positive association with dependent variable and found to be statistically insignificant.

Table 7: Factor determining Rice Production in Dimapur District: Regression Analysis

Sl. No.	Coefficient	Singrijan	Nihoto	Nihokhu	Dimapur
1	Constant	2.564	4.454	3.423	3.365
2	Farm Size	0.095	0.109	0.111	0.073
		(10.95)*	(8.13)*	(8.16)*	(12.44)*
3	Household Age	-0.095	-0.017	-0.019	-0.066
		(0.75)	(0.12)	(0.14)	(0.70)
4	Household Education	0.035	-0.027	-0.037	-0.035
		(2.14)**	(0.78)	(2.02)**	(2.55)**
5	Family Income	0.129	-0.142	-0.144	-0.005
		(2.23)**	(2.56)*	(2.58)*	(0.08)
6	Household Assets	-0.051	0.155	0.146	0.042
		(0.81)	(2.87)*	(2.73)*	(2.96)*
7	Cost on Pesticides	-0.085	-0.038	-0.042	0.089
		(0.78)	(0.44)	(0.48)	(2.39)**
8	Seed Cost	—	-0.041	0.001	-0.062
			(0.22)	(0.01)	(0.23)
9	Fertilizer Cost	-0.313	-0.157	-0.191	-0.245
		(2.48)**	(0.65)	(0.79)	(2.50)**
10	Manure Cost	0.183	0.029	0.038	-0.018
		(0.91)	(0.12)	(0.16)	(0.13)
11	Indebtedness	0.023	0.055	0.053	-0.146
		(0.64)	(1.02)	(0.98)	(3.05)**
12	Technological Cost	0.600	0.065	0.062	0.090
		(2.28)**	(0.42)	(0.41)	(0.54)
13	Labour Cost	0.702	1.042	0.274	0.237
		(0.77)	(2.12)**	(0.93)	(0.76)
R^2		0.913	0.893	0.896	0.796
F-Change		47.14	29.11	26.67	44.56
N		50	50	50	150

*Note: Figures in the parenthesis indicates 't' values; *, and ** indicates 1 percent and 5 percent significance.*

In case of Nihoto village the coefficient of both the farm size and household assets shows statistically significant at 1 percent level. It indicates that for every 1 percent increase in the level of farm size and household assets productivity increases by 0.109 and 0.155 times respectively. On the other hand the coefficient of family income shows negative and statistically significant at 1 percent level, indicating that the increase in the level of income of the farmers makes them better off and sometimes it results in lowering the famer's efficiency since he has better income to meet his needs and might not give his full ability and might also get carried away to try another business activity. However, the coefficient of labour cost shows a positive and statistically significant at 5 percent level.

The regression results in Nihokhu village shows the coefficient of farm size and household assets to be statistically significant at 1 percent level, On the contrary farmer's education and family income is associating a negative relation with the dependent variable and is significant at 5 percent level and 1 percent level respectively. Other variables such as seed cost, manure cost, indebtedness, technological cost and labour are also found to be positive but are insignificant. The overall regression analysis of the three villages under Dimapur district indicates that farm size, household assets shows a positive and statistically significant at 1 percent level each. While the coefficient of cost on pesticides shows positive association with dependent variable and statistically significant at 5 percent level.

Table 8: Factor determining Rice Production in Phek District: Regression Analysis

Sl. No.	Coefficient	Pfutseromi	Chizami	Kikruma	Phek
1	Constant	3.383	2.168	5.418	3.568
2	Farm Size	0.191	0.215	0.214	0.206
		(15.75)*	(17.21)*	(8.00)*	(22.96)*
3	Household Age	0.104	0.013	0.132	0.063
		(2.46)**	(0.18)	(0.75)	(1.15)
4	Household Education	-0.004	0.005	-0.000	0.001
		(0.28)	(0.30)	(0.01)	(0.07)
5	Family Income	-0.00	-0.013	0.084	-0.029
		(0.01)	(0.28)	(2.18)**	(2.11)**
6	Household Assets	-0.028	-0.019	0.009	0.031
		(0.85)	(0.33)	(0.13)	(2.59)*
7	Cost on Pesticides	-0.118	0.114	0.210	-0.051
		(0.86)	(0.82)	(0.59)	(0.61)
8	Seed Cost	0.030	0.162	-0.335	-0.003
		(0.46)	(2.03)**	(0.74)	(0.05)
10	Manure Cost	0.024	0.063	-0.013	0.017
		(0.60)	(0.81)	(0.13)	(0.46)
11	Indebtedness	0.009	0.048	0.040	-0.003
		(0.36)	(2.29)**	(0.48)	(0.15)
12	Technological Cost	0.959	-0.014	0.052	0.026
		(2.97)*	(0.34)	(0.48)	(0.78)
13	Labour Cost	0.150	0.372	-0.299	0.114
		(0.51)	(0.99)	(0.54)	(0.52)
	R2	0.914	0.938	0.814	0.874
	F-Change	36.75	52.80	15.11	87.09
	N	50	50	50	150

*Note: Figures in the parenthesis indicates 't' values; *, and ** indicates 1 percent and 5 percent significance.*

Similarly, in Phek district, the regression results in table 8 shows that in Pfutseromi village the coefficient of farm size and technological cost are positive and statistically significant at 1 percent level. It indicates that for every 1 percent increase in the farm size production increases by 0.191 times and for every 1 percent increase in technological cost produce 0.959 times additional units of production. On the other hand, the age of household head shows a positive and statistically significant at 5 percent level. In the same way the regression coefficients in Chizami village shows that the farm size,seed cost and indebtedness are positive associated with dependent variable and statistically significant at 1 and 5 per cent respectively. Whereas, The coefficients of farm size and family income in Kikruma village is found to be positive and statistically significant at 1 and 5 percent level.

The overall regression results in Phek district depicts that the coefficient of farm size and household assets to be positive and statistically significant with the dependent variable and statistically significant at 1 percent level. Whereas, the coefficient of family income shows a negative and statistically significant at 5 percent level. It indicates that as family income increases the farmers put less efforts and distracting towards other business activities since farming is more uncertain and varied.

Production Efficiency: Cobb-Douglas Production Function

The Cobb–Douglas form was developed and tested against statistical evidence by Charles Cobb and Paul Douglas during 1927–1947. Cobb–Douglas production function is a particular functional form of the production function, widely used to represent the technological relationship between the amounts of two or more inputs (particularly physical capital and labor) and the amount of output that can be produced by those inputs.

The result of Cobb-Douglas production of Dimapur district shows in table 9 that capital plays the most important role in production efficiency of rice in Dimapur with statistically at 1 percent level of significance. While in Nihoto village both capital and labour shows expected signs but statistically insignificant whereas, in Nihokhu village both capital and labour are equally important for production efficiency to generate more returns per acre.

Table 9: Cobb Douglas Production Function of Wet Rice Cultivation (WRC) in Dimapur District

Sl. No.	Variables	Coefficient	Singrijan	Nihoto	Nihokhu	Dimapur
1	Constant	α_0	2.901	16.248	2.658	11.854
2	Capital	β_K	-2.165 (2.05)**	-0.657 (0.59)	1.693 (2.19)**	-1.171 (2.44)*
3	Labour	β_L	2.520 (1.06)	-2.203 (0.91)	-0.910 (2.20)**	-0.582 (1.23)
4	$\sigma^2 = \sigma v^2 + \sigma u^2$		0.081	0.101	0.067	-0.165
5	Log Likelihood		-4.298	0.376	17.524	-6.482
6	No of Observation		50	50	50	150

*Note: Figures in the parenthesis indicates 't' values; *, and ** indicates 1 percent and 5 percent significance.*

Table 11: Cobb Douglas Production Function of Wet Terrace Cultivation (WRC) in Phek District

Sl. No	Variables	Coefficient	Pfutseromi	Chizami	Kikruma	Phek
1	Constant	α_0	1.979	9.002	4.604	3.266
2	Capital	β_K	0.383 (0.96)	1.047 (3.61)*	1.284 (4.07)*	0.862 (5.83)*
3	Labour	β_L	0.349 (0.48)	-2.028 (2.07)**	-1.139 (1.28)	-0.411 (0.74)
4	$\sigma^2 = \sigma v^2 + \sigma u^2$		0.026	0.042	0.040	0.037
5	Log Likelihood		35.93	20.537	23.886	71.020
6	No of Observation		50	50	50	150

In the same way, the results in Phek district shows that capital plays more predominant role than labour and indicates statistically significant at 1 percent significance level. In case of Pfutseromi both labour and capital are showing a positive sign but are statistically insignificant. On contrary to Chizami village that both labour and capital are equally important to make production efficiency of rice cultivation. Whereas, in Kikruma village only capital showing significant at 1 percent level of significance. It is an interesting to note that though the capital shows positive significant in most villages, the labour is also an important determinant for enhancing the production and productivity in all the selected villages both in Dimapur and Phek districts by the farmers reluctant to use high advance technology in their farming activities.

CONCLUSION

The present study revealsthat the farm activities in Nagaland is more prevailing labour intensive than capital.Wet rice cultivation is found to be more cost effective than wet terrace and received higher revenue. The result from regression analysis shows that the coefficient farm size and household assets to be positive and statistically significant with the dependent variable and is positive and statistically significant at 1 percent level. However, age and education of head of household, manure cost, technological cost, and labour cost shows positive association but is statistically insignificant. The Study reveals under wet rice cultivation in Dimapur district the farmers are more lucrative than their counterparts in Phek practicing terrace farming. Subsidized inputs, farm equipment's, institutional credit and extensive services to the farmers is very much essential for the farmers and the government should come forward to take and affirmative action plan by promoting farming sector through involvement of agriculture scientists from concerned departments and with the setting up of more Rice Research Centers in the State.

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