IOSR Journal Of Humanities And Social Science (IOSR-JHSS)
Volume 17, Issue 1 (Nov. - Dec. 2013), PP 48-55
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

A Study on Resource Use Efficiency of Input Factors with Reference to Farm Size in Paddy Cultivation in Nellore District

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Abstract: *Crop-wise production function analysis will clearly indicate many points which are not evident in aggregate and size-wise models. But crop-wise analysis is a farm of aggregate model as the output of a crop coming from different size enterprises has been put together. Land is an important factor for production and its effect on technology must be fully emphasized. It is only an inter-size analysis of production function for a particular crop, which can do away the limitations of an aggregate crop model. Inter-size crop models would also indicate the relative superiority of different crops for different size-group of farms that it is helpful for crop-cum-size level planning. Hence the present study aims to analyse the resource use efficiency of input factors in different size-level farms cultivating staple crop-paddy based on entire sample of Farms in three revenue mandals of Nellore District, Andhra Pradesh. Data was collected for the variables with the help of survey method through personal interviews of the farmers selected through mixed sampling. By studying the Marginal Value Products of factors of production, we assessed the relative importance of factors of production.*
Key Words: *Resource use Efficiency, Marginal Value Product, Marginal Cost, regression Co-efficient Geometric Mean.*

I. Introduction

Production is a process, where by some goods and services called inputs and transformed into other goods and services called outputs. Many types of activities are involved in the production including changes in farms, location and the time of use of products. Each of these changes involves the use of inputs to produce the desired outputs. The farms outputs of products depends upon the quantities of inputs used in production. This relation between input and output can be characterized by a production function. A production function provides information concerning the quantity of output that may be expected when particular inputs are combined in a specific manner. The chemical, physical and biological properties determine the kind and amount of output which will be received from particular combination of inputs.

Crop-wise production function analysis will clearly indicate many points which are not evident in aggregate and size-wise models. But crop-wise analysis is a farm of aggregate model as the output of a crop coming from different size enterprises has been put together. Land is an important factor for production and its effect on technology must be fully emphasized. It is only an inter-size analysis of production function for a particular crop, which can do away the limitations of an aggregate crop model. Inter-size crop models would also indicate the relative superiority of different crops for different size-group of farms that it is helpful for crop-cum-size level planning.

There are number of studies on the agricultural sector in Nellore district. Among these studies, the research on agricultural production is very limited. The empirical investigations are needed to study the resource use efficiency of input factors in inter-size crop models. Hence, the empirical and scientific investigational study of resource use efficiency of input factors in the rural economy of Nellore district is an important phenomena. In the present study, an attempt has been made to study the resource use efficiency of input factors in different size-level farms cultivating paddy crop basing on entire sample of farms of three mandals, namely, Kaligiri, Muttukur and Pellakur of Nellore district of Andhra Pradesh.

II. Review of Literature

Hanumantha Rao[1] has used production function to analyse agricultural data. His contribution lies in the adoption of disaggregated approach. He runs regression separately for farmers in different size-groups and also for three natural regions of the Hyderabad State. He used Cobb-Douglas Function and relates production with inputs of land and labour. Firstly, he finds positive production elasticity for labour. Second and important one is the production elasticity of labour is higher for large farms with holdings above 5 to 10 acres and it is contradicted in the case of small farmers. Further, he finds the production elasticity of labour to be higher than that of land in two relatively less fertile regions and a reverse situation in the track of Marathwada.

Mathur and Balishter[2] studied the impact of HYV's of crops on farm labour use. An attempt has been made to know the extent of labour utilization across different size of farms under various types of HYV's in a sub-region of Agra district of Utter Pradesh. It is pointed out that average labour use per hectare in high-yielding varieties is higher than that of other type of varieties. It is also observed that the family employment has increased by 8 percent in 1967-68 over 1966-67 due to switching over to high-yielding varieties.

Venkatesam, Naidu and Venkateswarlu[3] discussed the resource use efficiency on maize farms in Karimnagar district of Andhra Pradesh. They adopted Cobb-Douglas Production Function to study the resource use efficiency of sample farms. The authors identified in the case of maize production, contribution of family labour and total cost of cultivation decreases with the increase in farm size. Small farmers used more manures and less fertilizers, whereas medium and large farmers used more fertilizers and less manures. It is also observed that the average yield of hybrid maize was more on small farms and decreased as the farm size increased. Cost of production was the lowest in small farms.

Bal[4] studied the factor share in farm income and farm income inequality in Punjab. It was observed that the size of the farm accounted for the major part of the farm income inequality. It was further showed that large farms had better access to the yield increasing input as a result of which the skewness in income distribution is more than that of skewness in farm size distribution. He told that speedy implementation of land reform measures can go a long way in reducing the existing disparities in farm incomes and farm income distribution.

Sharma and Sharma[5] study concerns with micro evidence from an agriculturally developed region, where new agricultural technology had permeated quite thoroughly, showed the existence of inverse farm size-productivity relationship in the production of wheat and paddy. The results showed that the small farms used higher amount of human labour and fertilizer as compared to higher farm size categories. The regression results also confirmed the inverse relationship between the farm-size and inputs use. In broad terms, the results of the study do not support the view that the inverse farm size-productivity relationship has disappeared with the spread of new agricultural technology.

Singh and Pandey[6] studied the resource use efficiency in a dry farming area of Banda district of Utter Pradesh. The study concluded that the farmers are handicapped with inadequacy of growth promoting inputs such as manure, fertilizer and irrigation facilities and are using the conventional input, labour in excessive quality due to non-availability of other non-farmer employment opportunities. The author observed that the new technology of high yielding variety was still in its infancy owing to the un assured irrigation facilities. Therefore, policy for the growth of this dry farming area of crop thriving under low rain-fed conditions and adequate provision for credit and non-farm employment is made for raising the farm productivity and for uplifting the standard of living of the people in the region.

Rathore[7] studied the contribution of various factors such as neutral technology non-neutral technology and other inputs to the overall productivity differences and / or the overall efficiency differences between small and large farms of Himachal Pradesh and Maharashtra. The study reveals that while applying neutral technology the farm productivity will be less on small farms on the other hand applying non-neutral technology, small farms have an advantage over the large ones. After the neutral and non-neutral technology components, the study finds that present technology is also in favour of large farms.

Ninan[8] studied the pattern and intensity of labour use in the tapioca and paddy cultivation. The study shows that there is a positive association between per acre labour input and tapioca/paddy yield per acre. It was found that per acre family labour input is inversely related to size of holding both in the case of tapioca and paddy. Average productivity for tapioca was found to be higher than that of paddy in all size groups.

III. Objective of the Study

The following is the objective of the study:

- To study the Agricultural resource use efficiency of input factors in different size-level farms cultivating paddy crop in three revenue mandals of Nellore District, Andhra Pradesh.

IV. Data and Methodology

The following methodology is adopted to study the above objectives. The present study extends over Nellore district of Andhra Pradesh. A multistage random sampling design was used. We purposefully selected three mandals, Namely Kaligiri, Muttukur and Pellakur of Nellore District at the first stage and later with help of random sampling ten to twelve villages were selected from each Mandal. After the selection of villages a complete list of agricultural families was prepared. As it is generally believed that the technology was size-based, the list of farmers was further divided into three categories of farms defined as under;

0.00	acres	-	2.50	acres	-	small farms
2.51	acres	-	5.00	acres	-	medium farms
5.01	acres and above				-	large farms

From the sub-divided list of farmers 15-20 farmers were selected from each village for preparing a sample of 420 farmers taking for Kaligiri, Muttukur and Pellakur mandals. Data was collected for the explanatory and explained variables with the help of survey method through personal interviews of the farmers selected through mixed sampling for this study relating to the agricultural year 2004-2005.

4.1. Specification of variables

A great deal of caution is essential in the selection, classification and aggregation of input variables used in the production process for studying resources productivity. Different researchers have classified and aggregated farm inputs in different ways suitable for their studies. Various ways of classifying and aggregating input variables in production function studies together with a brief description of variables used as explanatory variables in the present study are giving below.

4.1.1. Bullock-Labour

Preparation of farm is an important agricultural work and bullock-power have been taken as an explanatory variable by a number of writers. Chaudhari[9], Reddy and Sen[10], Hopper[11] and Radhakrishna[12] have used it in terms of plough unit days consisting of one pair of animal-labour day and one human-labour day comprising one plough unit. While Rajkrishna[13], Badal and Singh[14] specified this variable in terms of bullock-labour days, Robellow and Desai[15] included a labour with a pair of bullocks. Here, we also include one human-labour to a pair of bullocks and specify them in value terms. This done with the help of accounting prices.

4.1.2. Human-Labour

Human-labour too, has been used as an explanatory variable in the estimation of production functions either in physical units of time or in value of terms. Shan[16] and Goyal[17] used all human labour while, Hopper[11] and Mathur[18] used all human-labour except those associated with plough unit in value terms. Sharma and Sharma[19], Hanumantha Rao[2], Rajkrishna[13], Singh[20] and Eswara Prasad[21] have used all human-labour in terms of man-days. We also include human-labour as an explanatory variable but from it exclude those labourers who are engaged in traditional irrigation work and are associated with bullock units. Variable is specified in terms of rupees.

4.1.3. Seeds

A few writers have used seeds as explanatory variable in their functions. Prasad[22], Debnarayan Sarker and Sudptia De[7] used seeds as a separate explanatory variable in his study terms of expenditure on seeds. We also include seeds in our functions, the prices of seeds are determined at the prevailing market price of the seeds at the seeding time.

4.1.4. Irrigation

Assured and effective irrigation which has been one of the most important factors in the production function studies. Rajkrishna[13], Timothy and Krishna Moorthy[23] has specified this variable in terms of expenses on irrigation. We also specify it in the same term. Expenses on irrigation include permanent of wages to labourers used in traditional system of irrigation, water charges paid to the Government for the use of state tube-wells, hire-price of the water received from private tube-wells and pumping sets. Expenses also include accounting prices for the water received from farmers own pumping sets and tube-wells.

4.1.5. Fertilizer

Fertilizer is one of the most important components in Agricultural Production. Parikh[24] and Shan[16] Mythili and Shanmugam[25] have used chemical fertilizers as separate variable, while Basak and Choudhary[26] has included manure along with chemical fertilizers as an explanatory variable. Yadav and Gangwar[27] considered various categories of chemical fertilizers as independent explanatory variables. In the present study, though category-wise chemical fertilizer is not taken, chemical fertilizers and pesticides and natural fertilizers are specified as separate variables, and taken in value terms. While expenses on chemical fertilizer are the actual expenses, help of accounting price has been taken to determine the expenses on traditional fertilizers, like seen manure, compost burnt of waste goods and cow-dewing.

4.1.6. Plant Protection

Plant protection measures are included as explanatory variable. Prasad[22] and Badal and Singh[14] taken them in terms of expenditure on their use. In our study also this variable is specified in terms of actual expenditure.

Like specification of variables, specification of an equation showing functional relationship between inputs and output is an important aspect of production function studies. Many of the economists used the generalized Cobb-Douglas Production Function to study the relation between the inputs and output in production analysis. The following production function has been specified for Inter-size crop level analysis.

V. Model Specification

By studying the Marginal Value Products of factors of production, we can assess by their relative importance of factors of production. Marginal Value Product of X_i, the i^{th} input is estimated by the following formula:

$$MVP\left(\mathrm{X_i}\right) = \alpha_i \frac{G.M.(Y)}{G.M.(X_i)}$$

Where,

G.M. (Y_i) and G.M. (X_i) represent the geometric means of output and input respectively, α_i is the regression Co-efficient of i^{th} input.

VI. Results and Discussions

Efficiency analysis from the point of view of different crops cannot be complete if it is not analised size-wise, because it is the size-wise analysis of efficiency which tells us the relative superiority of a particular size of a particular crop.

In order to evaluate the Economic efficiency of farmers in three mandals under the study for different size-group of paddy crop, it was calculated the ratios of marginal value products to their respective marginal cost and they were shown in table – 1, 2 and 3.

6.1. Kaligiri Mandal

The calculated ratios of MVP and MC pertaining to Kaligiri mandal are given in table 1.

Table 1: Ratios of Marginal Value Product of Input Factors to their Marginal Cost Related to Paddy

Inputs	Description of Inputs	Kaligiri Mandal								
		Small Farms			Medium Farms			Large Farms		
		MVP	MC	Ratio	MVP	MC	Ratio	MVP	MC	Ratio
X_1	Bullock-labour	-0.13108	1.000	-0.13108	0.00484	1.000	0.00484	2.209798	1.000	2.20979
X_2	Expenditure on Tractor	0.09767	1.000	0.09767	0.05705	1.000	0.05705	0.34310	1.000	0.34310
X_3	Human-labour	12.36275	1.000	12.36275	2.084914	1.000	2.08914	3.31261	1.000	3.31261
X_4	HYV Seeds	5.77078	1.000	5.77078	9.81239	1.000	9.81239	13.91174	1.000	13.91174
X_5	Chemical Fertilizers	-1.28033	1.000	-1.28033	3.60856	1.000	3.60856	-1.79914	1.000	-1.79914
X_6	Manures	0.4525	1.000	0.4525	2.41399	1.000	2.41399	1.49658	1.000	1.49658
X_7	Pesticide and other Plant Protection Expenditure	8.06269	1.000	8.06269	6.06512	1.000	6.06512	5.61715	1.000	5.61715

6.1.1. Small Farms

From table 1, it is noticed that the ratios of MVP and MC of human-labour, HYV seeds and pesticides and other plant protection methods are greater than unity and it indicates the under utilization of human-labour, HYV seeds and pesticides and other plant protection methods. The ratios of MVP and MC of bullock-labour, expenditure on tractor, chemical fertilizers and manures are less than unity and it indicates the over utilization of bullock-labour, expenditure on tractor, chemical fertilizers and manures. The technological indicators –chemical fertilizers, expenditure on tractor are over utilized. The HYV seeds and pesticides and other plant protection methods are under utilized. Hence, the pattern of resource use in small farms of paddy in Kaligiri mandal needs some modification. The under utilized factors may be raised and the over utilized factors may be reduced in the production process of paddy crop in Kaligiri mandal.

6.1.2. Medium Farms

The ratios of MVP and MC of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are greater than unity and it indicates the under utilization of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods. The ratios of MVP and MC of bullock-labour, expenditure on tractor are less than unity and it indicates the over utilization of bullock-labour, expenditure on tractor. It observed that the ratios of technological indicators – HYV seeds, chemical fertilizers and pesticides and other plant protection methods are under utilized. Hence, the pattern of resource use in medium farms of paddy in Kaligiri mandal needs some modification, particularly, application of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods should be increased whereas bullock-labour and expenditure on tractor should be decreased. It was concluded that the technological factors – HYV seeds, chemical fertilizers and pesticides and other plant projection methods may be increased also the expenditure on tractor may be decreased to obtain the optimum production.

6.1.3. Large Farms

The ratios of MVP and MC of bullock-labour, human-labour, HYV seeds, manures and pesticides and other plant protection methods are greater than unity and it indicates the under utilization of the above said five inputs. The ratio of MVP and MC of expenditure on tractor, chemical fertilizers are less than unity and it indicates the over utilization of chemical fertilizers and expenditure on tractor. While expenditure on tractor is marginally under utilized, the use of bullock-labour, human-labour, HYV seeds and pesticides and other plant protection methods are deficient. Therefore the pattern of resource use in large farms of paddy in Kaligiri mandal needs some modifications, particularly, in the application of HYV seeds, human-labour, manures and pesticides and other plant protection methods should be increased to obtain more yield. It is influenced that the technological factors – HYV seeds and pesticides and other plant protection methods may be raised and the expenditure on tractor, chemical fertilizers may be reduced to get more paddy output in large farms.

6.2. Muttukur Mandal

The calculated ratios of MVP and MC pertaining to Muttukur mandal are given in table 2.

Table 2: Ratios of Marginal Value Product of Input Factors to their Marginal Cost Related to Paddy

Inputs	Description of Inputs	Muttukur Mandal								
		Small Farms			Medium Farms			Large Farms		
		MVP	MC	Ratio	MVP	MC	Ratio	MVP	MC	Ratio
X_1	Bullock-labour	8.8274	1.000	8.8274	-	1.000	-	-	1.000	-
X_2	Expenditure on Tractor	-0.36847	1.000	-0.36847	-29.20931	1.000	-29.20931	-1.59623	1.000	-1.59623
X_3	Human-labour	9.53869	1.000	9.53869	33.33658	1.000	33.33658	7.71332	1.000	7.71332
X_4	HYV Seeds	4.51809	1.000	4.51809	51.15813	1.000	51.15813	-3.87566	1.000	-3.87566
X_5	Chemical Fertilizers	3.50764	1.000	3.50764	33.29840	1.000	33.29840	0.31739	1.000	0.31739
X_6	Manures	0.79176	1.000	0.79176	-0.60039	1.000	-0.60039	-0.25992	1.000	-0.25992
X_7	Pesticide and other Plant Protection Expenditure	4.57107	1.000	4.57107	16.95225	1.000	16.95225	18.39072	1.000	18.39072

6.2.1. Small Farms

From table 2, it is observed that the ratios of MVP and MC of bullock-labour, human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods are greater than unity and it indicates the under utilization of above said five inputs. The ratios of MVP and MC of expenditure on tractor and manures are less than unity and it indicates the over utilization of these variables. The use of these two factors are in excess while the use of bullock-labour, human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods are deficient. Hence, the pattern of resource use in small farms of paddy in Muttukur mandal needs some modification, particularly, in the use of technological factor like HYV seeds, chemical fertilizers and other plant protection methods should be increased to obtain more yield. Similarly, the expenditure on tractor may be reduced.

6.2.2. Medium Farms

The ratios of MVP and MC of human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods are greater than unity and it indicates under utilization of above said variables. The ratios of MVP and MC of expenditure on tractor and manures are less than unity and it indicates the over utilization of these two factors. It indicates the excess utilization of these two variables while the usage of other

four variables are in significant. Hence, the pattern of resource use in medium farms of paddy in Muttukur mandal needs some modifications, particularly, application of human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods should be increased to obtain more yield. Finally it is inferred that the technological factors like HYV seeds, chemical fertilizers and other plant protection methods may be reduced.

6.2.3. Large Farms

The ratios of MVP and MC of human-labour and pesticides and other plant protection methods are greater than unity and it indicates under utilization of the human-labour and pesticides and other plant protection methods. The ratio of MVP and MC of expenditure on tractor, HYV seeds, chemical fertilizers and manures are less than unity and it indicates the over utilization of above said four variables. It is noticed that the chemical fertilizers are marginally utilized, the use of human-labour and pesticides and other plant protection methods are deficient. Hence, the pattern of resource use in large farms of paddy in Muttukur mandal needs some modifications, particularly, the use of human-labour and pesticides and other plant protection methods should be increased whereas the use of chemical fertilizers, expenditure on tractor and HYV seeds may be decreased.

6.3. Pellakur Mandal

The calculated ratios of MVP and MC pertaining to Pellakur mandal are given in table 3.

Table 3: Ratios of Marginal Value Product of Input Factors to their Marginal Cost Related to Paddy

Inputs	Description of Inputs	Pellakur Mandal								
		Small Farms			Medium Farms			Large Farms		
		MVP	MC	Ratio	MVP	MC	Ratio	MVP	MC	Ratio
X_1	Bullock-labour	-6.23757	1.000	-6.23757	-	1.000	-	8.09365	1.000	8.09365
X_2	Expenditure on Tractor	-0.02536	1.000	-0.02536	5.93012	1.000	5.93012	11.36916	1.000	11.36916
X_3	Human-labour	2.30654	1.000	2.30654	10.03680	1.000	10.03680	0.34454	1.000	0.34454
X_4	HYV Seeds	25.36753	1.000	25.36753	11.29794	1.000	11.29794	5.43912	1.000	5.43912
X_5	Chemical Fertilizers	4.45380	1.000	4.45380	-1.54718	1.000	-1.54718	1.73378	1.000	1.73378
X_6	Manures	1.19237	1.000	1.19237	-4.64353	1.000	-4.64353	2.07287	1.000	2.07287
X_7	Pesticide and other Plant Protection Expenditure	-0.36258	1.000	-0.36258	2.26263	1.000	2.26263	1.65829	1.000	1.65829

6.3.1. Small Farms

From table 3, it is observed that the ratios of MVP and MC of human-labour, HYV seeds, chemical fertilizers and manures are greater than unity and it indicates under utilization of these factors. The ratios of MVP and MC of bullock-labour, expenditure on tractor and pesticides and other plant protection methods are less than unity and it indicates over utilization of these factors. Therefore, in order to obtain more yield of paddy in small farms of Pellakur mandal, application of human-labour, HYV seeds, chemical fertilizers and manures should be increased while bullock-labour, expenditure on tractor and pesticides and other plant protection methods may be decreased. Hence, the technological factors HYV seeds, chemical fertilizers may be raised and expenditure on tractor and pesticides and other plant protection methods may be reduced to obtain more paddy output.

6.3.2. Medium Farms

The ratios of MVP and MC of expenditure on tractor, human-labour, HYV seeds, and pesticides and other plant protection methods are greater than unity and it indicates under utilization of above said variables. The ratios of MVP and MC of chemical fertilizers and manures are less than unity and it indicates the over utilization of chemical fertilizers and manures. Therefore, these two factors are used excessively while the use of expenditure on tractor, human-labour, HYV seeds and pesticides and other plant protection methods are deficient. In order to obtain more yield of paddy in medium farms of Pellakur mandal, particularly, application of expenditure on tractor, human-labour, HYV seeds and pesticides and other plant protection methods may be increased and the chemical fertilizers may be reduced.

6.3.3. Large Farms

The ratios of MVP and MC of bullock-labour, expenditure on tractor, HYV seeds, chemical fertilizer, manures and pesticides and other plant protection methods are greater than unity and it indicates the under utilization of above said six variables. Whereas the ratio of human-labour is less than unity and it indicates the over utilization. The chemical fertilizers and pesticides and other plant protection methods are marginally under

utilized, the use of bullock-labor, expenditure on tractor, HYV seeds and manures are deficient. Therefore, to obtain more yield of paddy in large farms of Pellakur mandal, application of technological factors like expenditure on tractor, HYV seeds, chemical fertilizers and pesticides and other plant protection methods may increased.

VII. Conclusions

The empirical analysis conducted above reveals that the MVPs of some input factors are less than unity for all categories of the sample cultivators. If these figures are taken at their face value it would imply that these input factors use by the sample cultivators is 'excessive'. It may also be observed that the MVPs of some input variables are substantially higher than unity, implying sub-optimal levels of use of these inputs by the cultivators.

There is excessive and sub-optimal levels of use of inputs by the sample cultivators. Thus implies that they are irrational in their input variables use behavior. The above analysis reveals the inappropriateness of the production functions for the analysis of input variables use behavior of cultivators.

The irrationality of inputs use behavior of cultivators may be influenced by the factors such as complementarity of input use, risk-preferences of cultivators, expectations regarding profits, asset position of cultivators, availability of information, availability of finance etc.

Hence, by providing financial assistance and establishing agricultural information centres for proper utilization of input variables by farmers may increase the paddy production.

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