EFFICIENCY OF FARMS IN A LOCAL LEVEL ECONOMY:
A STUDY IN THE POST LIBERALIZATION PERIOD IN WEST BENGAL

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Abstract

The diversity of special setting of local level rural economies is not confined to fine or distinct differences in agro-climatic characteristics of the economy. For one thing even when agro-climatic characteristics do not differ perceptively, the extent of their utilisation for strengthening the process of development often differs for historical or political reasons. Secondly, the co existence of local level economies with different degrees of utilisation of their purely natural characteristics offers us invaluable data for innovating methods to study not merely the productivities but also the degree of primacy of various facilities contributing to the heightening of output and employment. More importantly, however, there are many areas, and almost invariably the ones which are much away from the national or the state capital, which escape notice of the policy-makers and as a consequence are generally labelled as desertish or marginal areas. Plan for the development of these marginal areas remains as prolonged unfinished task yet after consuming of six decades of our national planning. Thirdly, the development so far had been made at the initiation of the local level economies with their own effort and owns resource is also needed to be flourished in front of the academic community of our country and abroad.

Key Words: development, agro-climatic, marginal, resource.

INTRODUCTION

The direction and magnitudes of productivity of land and labour, the two most important basic resources of any grass-root economy, occupy a paramount important position in the analysis of local level economic situation and hence local level planning. The importance of this kind of study stems from the fact that there is an infinite diversity among the economic agents of special circumstances of local level rural economies even when they appear covered by a haze of common markings. The diversity of special setting of local level rural economies is not confined to fine or distinct differences in agro-climatic characteristics of the economy. For one thing even when agro-climatic characteristics do not differ perceptively, the extent of their utilisation for strengthening the process of development often differs for historical or political reasons. **Secondly**, the co existence of local level economies with different degrees of utilisation of their purely natural characteristics offers us valuable data for innovating methods to study not merely the productivities but also the degree of primacy of various facilities contributing to the heightening of output and employment. More importantly, however, there are many areas, and almost invariably the ones which are much away from the national or the state capital, which escape notice of the policy-makers and as a consequence are

generally labelled as desertish or marginal areas. Plan for the development of these marginal areas remains as prolonged unfinished task yet after consuming of six and half decades of our national planning. **Thirdly**, the development so far had been made at the initiation of the local level economies with their own effort and owns resource is also needed to be flourished in front of the academic community of our country and abroad. **The present exercise is a mere attempt to expose a local level economy like to test the farm efficiency at individual level by using the Data Envelopment Analysis (DEA) Technique, occasionally called the Frontier Analysis.**

ORIGIN OF DEA

It is, in order in analyzing relative efficiency, to mention the names of the authors like Debreu (1951), Koopmans (1951) and Farrell (1957, models for evaluating productivity) who for the first time understood and elaborated the concept of relative efficiency. However, as a mathematical programming DEA technique, although based on earlier work of Ferrell, has been used by the researchers in a number of fields since its inception in the year 1978 by Charnes , Cooper and Rhodes (CCR)) and further generalized by Banker, Charnes, and Cooper (BCC) (1984). At present it is an important non-parametric method of evaluation of efficiency at different activity levels in the productive as well as in the service sector of an economy. Using a sample of actually observed input-output data, it derives a benchmark output quantity with which the actual output of an individual firm can be compared for efficiency measurement. In their originating article Charnes, Cooper and Rhodes (CCR) described DEA as a "mathematical programming model applied to observational data (that) provides a new way of obtaining empirical estimates of relations- such as the production functions and/or efficient production possibility surfaces- that are cornerstones of modern economics". DEA is a methodology directed to frontiers rather than central tendencies as in the case of regression. Thus we can apply this analysis at the frontier level particularly to measure the efficiency of the individual farm operator.

STUDY AREA

For the purpose of this present study the local level rural economy being studied which is made up with the villages around the village market town of **Baneswar** and the market town itself. The two villages are *Ichhamari* and *Borokhata*. The first village is nearer to the market town Baneswar and relatively more developed in all respects than the second village. Elsewhere these two villages will be termed as village-1 and Village-2. In fact, the whole Baneswar Gram Panchayat area is synonymous with the local level rural economy being studied. The sale town or market town of Baneswar is the centre of interaction of the activities of the villages around.

METHODOLOGY

There is no end of diversities of methodologies used in rural studies. The National Sample Survey has used a sample design that uses only sample households on a broad division of rural and urban areas. Such designs are not suitable for analysis of a very large number of variables. Some experts devised a method of studying modal farms for input-output relations. The method might be useful for obtaining information about the productivity and use of inputs in different areas and serves as a basis for comparison of efficiency of agriculture in different local rural economies. This method can also be used as a basis for the planning of an extension service for farm management. Some Indian investigators have resorted to sample survey without a scientific design. They have used only elementary Census data to build a simple sample frame. In many cases about 100 households cover such a sample. The difficulty of such a

sample is that since the sample is not stratified on the basis of size of farms, the sample is not good enough for study of variation of output and inputs according to size.

Thus we are in need of selecting a methodology that will be more suitable for our type of object. For the finding of farm efficiency we resort to a two-phase and one stage stratified sample. In the first phase, we have surveyed each and every farm household of the sample villages Ichhamari and Borokhata with a specially prepared household schedule. In the second phase we have surveyed 121 households from this local level economy on the basis of farm size excluding the land less households for measuring efficiency of farm activities. Finally we have selected 33 farms for efficiency measurement. All information is collected with a specially prepared activity schedule for the period of 2014-15 which is synonyms to our traditional agricultural year.

ANALYSIS OF DATA

To test the relative efficiency of the farms of our sample villages we have made some assumptions to justify our findings. They are:

- All land should be used throughout the agricultural year;
- Farms will produce three crops viz. Aman paddy, Potato and Boro paddy in an agriculture year;
- Existing technology mix will be used in the production process;
- There will be no input and output market constraints;
- Agricultural crop year should be a normal crop year;
- Agricultural production will be indifferent of size of the farms;

On the basis of the above assumptions the farms that will produce three above mentioned crops will be our objective farms and the farms will be relatively efficient when they will be able to use the appropriate combination of inputs for producing the required amount of output. There are 33 farms out of 121 farms that have successfully raised three crops namely Aman paddy, Potato and Boro paddy during the last agricultural year. Thus according to our assumptions these 33 farms are termed as the objective farms. Now we are in a position to make a comparative performance assessment among the farms by using the DEA technique. Under this technique each of the 33 farms are regarded as the 33 Decision Making Units (DMUs) and we measure the relative efficiency of each DMU within the sample and within the reference period. In order to calculate the efficiency of a particular DMU we have used mathematical programming techniques. To determine the relative value of the various outputs and inputs that maximizes a specific DMU's efficiency score we assume that a particular DMU may utilize any combination of inputs and outputs in order to maximize its own efficiency score subject to the constraint all other DMU's efficiency scores using the particular DMU's weights are less than or equal to one. It is important to note that DEA models produce only relative efficiency scores in comparison to all other DMUs

EFFICIENT AND INEFFICIENT FARMS IN USING INPUT COMBINATIONS

According to our measure, a DMU is said to be relatively efficient when it is able to use the appropriate combination of different inputs for raising the required level of output of a particular crop then its efficiency score will be 1. It simply means that the input combinations are being utilized properly to raise the required level of output by that particular DMU. Thus in case of efficient DMUs, the differences between the amount of input actually used (Score Data) and the required amount (Projection) will be zero for all the inputs. On the other hand, the inefficient

DMUs are those who fail to use their input combinations appropriately in raising the required level of output and the efficiency scores for them will be less than 1. For the relatively inefficient DMUs, the differences between the score data and projected data for all/some inputs will be either positive or negative. In this way we have measured farm's relative efficiency for the above mentioned crops.

Table 1: INPUT USE EFFICIENCY

Crops	Total	Efficient DMUs		Inefficient DMUs	
		Number	Percentage	Number	Percentage
Aman Paddy	33	21	63.6	12	36.4
Potato	33	18	54.5	15	45.5
Boro Paddy	33	26	78.8	07	21.2

Source: Field Survey- 2014-15

Apparently one can have an idea about the DMUs relative efficiency and in-efficiency from table 1. It appears from this table that DMUs of this area economy are mostly efficient in Boro paddy production. On the other hand, DMUs are least efficient in the production of potato. We have taken the farm data for a particular agricultural year. This kind of cross-sectional data often tempered by the ***input and output market shocks***. Normally, the farmers of this grass-root area are very much efficient in potato production. This relative inefficiency may be due to the so called Cob-Web that exists in the agricultural price-output conjecture. Another important cause of this type of relative inefficiency in case of potato production is the unavailability of good quality seeds in this grass-root economy. Again, in case of Aman Paddy the farmers of this region are efficient by tradition as it is the main agricultural crop of this region.

EFFICIENCY SCORES AND RANKS OF THE DMUs FOR DIFFERENT CROPS

We have an opportunity to exhibit the efficient DMUs according to their ranks in case of Aman paddy. We ranked the DMUs in bottom-top approach**.** So the DMU named as V_1 is relatively lower farm in our farm ranking. According to our programming result, the 30th DMU has been appeared as the most efficient DMU in case of Aman paddy production. Although we have chosen the DMUs haphazardly among the farms, but what remains to say is that the DMUs of the relatively lower land group are most efficient as they occupied the ranks 2nd to 8th in the ranking table. On the other hand, ranking of the inefficient DMUs is given in table 3. In comparison of tables 2 and 3 we can simply say that the relatively smaller farms are efficient and relatively bigger farms are inefficient in this sample economy.

The efficient DMUs according to their ranks are V_{30}, V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_{25}, V_{21}, V_{10}, V_{11}, V_{20}, V_{13}, V_{14}, V_{19}, V_{16}, V_{17}, V_{24}, V_{33}, and V_{32}.

Table 2: EFFICIENT DMUs BY RANKS (AMAN PADDY)

Rank	DMU	Score
1 (1st)	V_{30}	1
1 (2nd)	V_1	1
1 (3rd)	V_2	1
1 (4th)	V_3	1
1 (5th)	V_4	1

Source:	1 6th)	V_5	1
F	1 (7th)	V_6	1
i	1 (8th)	V_7	1
e	1 (9th)	V_{25}	1
l	1 (10th)	V_{21}	1
d	1 (11th)	V_{10}	1
	1 (12th)	V_{11}	1
S	1 (13th)	V_{20}	1
u	1 (14th)	V_{13}	1
r	1 (15th)	V_{14}	1
v	1 (16th)	V_{19}	1
e	1 (17th)	V_{16}	1
y	1 (18th)	V_{17}	1
-	1 (19th)	V_{24}	1
	1 (20th)	V_{33}	1
2 0	1 (21st)	V_{32}	1

14-15

The inefficient DMUs according to their ranks are V_{15}, V_{22}, V_9, V_{28}, V_{12}, V_{26} , V_{31}, V_{18} , V_8, V_{29}, V_{27}, and V_{23}.

Table 3: INEFFICIENT DMUs BY RANKS (AMAN PADDY)

Rank	DMU	Score
22	V_{15}	0.998358
23	V_{22}	0.998045
24	V_9	0.99534
25	V_{28}	0.990175
26	V_{12}	0.985795
27	V_{26}	0.984847
28	V_{31}	0.974961
29	V_{18}	0.967736
30	V_8	0.963531
31	V_{29}	0.952446
32	V_{27}	0.93982
33	V_{23}	0.909862

Source: Field Survey- 2014-15

We have also constructed table 4 where the reasons of inefficiency are self explanatory. But what remains to say is that out of 12 inefficient DMUs, 5 DMUs can be converted into efficient DMUs if these DMUs can use their home

labour, organic manure and insecticides in a little bit efficient manner. If this is so then the number of relatively efficient DMUs becomes 26 out of 33 DMUs. Thus the manner of management of inputs at this grass-root level economy appears as an important factor subject to the fulfillment of other assumptions.

Table 4: INEFFICIENT DMUs WITH REASONS (AMAN PADDY)

DMU	Score	Excess DEP S-(1)	Excess HOMLA S-(2)	Excess HILA S-(3)	Excess SEE S-(4)	Excess ORGM S-(5)	Excess INORGM S-(6)	Excess INSEC S-(7)
V_8	0.963	0	0	0	0	0	3.669	19.252
V_9	0.995	85.196	105.057	0	17.740	0	21.558	41.545
V_{12}	0.985	8.621	55.911	19.315	0	0	0	1.402
V_{15}	0.999	0	0	0	0	31.583	0	32.423
V_{18}	0.967	0	0	112.200	7.421	116.744	9.137	76.847
V_{22}	0.998	0	118.014	8.553	0	0	0	35.516
V_{23}	0.909	157.406	0	0	13.901	0	0	68.129
V_{26}	0.984	15.962	0	0	12.862	0	11.235	39.277
V_{27}	0.939	77.778	0	90.449	0	168.367	0	33.245
V_{28}	0.990	0	0	0	0	33.712	0	57.870
V_{29}	0.952	0	0	284.198	0	203.367	0	61.855
V_{31}	0.974	0	0	47.865	0	17.173	0	19.758

Source: Field Survey- 2014-15

It will be in order if we consider the relative efficiency of the DMUs in case of potato production, the second crop of our efficiency parameter. Here, what we have seen in case of Aman paddy, we have obtained a rather opposite picture of DMU efficiency. In case of potato production, the DMUs of the relatively higher land group rank in a better position in comparison to the DMUs of the lower land holding group. This has become possible simply due to their relatively higher educational knowledge and economic capacity of providing the good quality inputs in time. However, four DMUs of the land group "up to 2 Acres" and four DMUs of the middle land group have succeeded to register themselves in efficiency table. Our special studies of farms reveal that out of these 8 DMUs, the owners of 5 DMUs are engaged in service, the owners 2 DMUs are engaged in business and have their own deep tube-wells for irrigation. So, the tale of success of these DMUs is remaining the same.

The efficient DMUs according to their ranks are V_{33}, V_{32}, V_{31}, V_3, V_{30}, V_{28}, V_6, V_7, V_{24}, V_9, V_{10}, V_{11}, V_{23}, V_{22}, V_{26}, V_{27}, V_{29}, and V_{13}.

Table 5: EFFICIENT DMUs BY RANKS (POTATO)

Rank	DMU	Score
1 (1st)	V_{33}	1
1 (2nd)	V_{32}	1
1 (3rd)	V_{31}	1
1 (4th)	V_3	1

1 (5th)	V_{30}	1
1 (6th)	V_{28}	1
1 (7th)	V_6	1
1 (8th)	V_7	1
1 (9th)	V_{24}	1
1 (10th)	V_9	1
1 (11th)	V_{10}	1
1 (12th)	V_{11}	1
1 (13th)	V_{23}	1
1 (14th)	V_{22}	1
1 (15th)	V_{26}	1
1 (16th)	V_{27}	1
1 (17th)	V_{29}	1
1 (18th)	V_{13}	1

Source: Field Survey- 2014-15

The inefficient DMUs according to their ranks are V_5, V_{14}, V_8, V_1, V_2, V_4, V_{17}, V_{20}, V_{25}, V_{15}, V_{21}, V_{16}, V_{12}, V_{18}, and V_{19}.

TABLE 6: INEFFICIENT DMUs BY RANKS (POTATO)

Rank	DMU	Score
19	V_5	0.997517
20	V_{14}	0.996106
21	V_8	0.992154
22	V_1	0.986051
23	V_2	0.985333
24	V_4	0.984336
25	V_{17}	0.981542
26	V_{20}	0.980515
27	V_{25}	0.978133
28	V_{15}	0.968134
29	V_{21}	0.965826
30	V_{16}	0.965151
31	V_{12}	0.964509
32	V_{18}	0.96114
33	V_{19}	0.958373

Source: Field Survey- 2014-15

Table 7: INEFFICIENT DMUs WITH REASONS (POTATO)

DMU	Score	Excess DEP S-(1)	Excess HOM S-(2)	Excess HI LA S-(3)	Excess SEE S-(4)	Excess ORGM S-(5)	Excess INORGM S-(6)	Excess INSEC S-(7)	Excess IRRGWA S-(8)
V_1	0.986	0	3.292	40.065	0	0	199.724	44.462	253.187
V_2	0.985	0	242.337	0	0	86.482	112.303	0	164.035
V_4	0.984	0	0	0	122.242	0	58.026	49.132	219.841
V_5	0.997	22.302	6.739	0	0	0	40.063	59.864	0.387
V_8	0.992	90.783	64.094	0	181.072	83.362	91.587	0	11.904
V_{12}	0.964	4.833	104.075	0	0	230.763	56.542	58.861	217.051
V_{14}	0.996	0	538.084	0	114.091	0	47.691	67.412	282.675
V_{15}	0.968	5.325	96.491	0	95.866	363.966	66.721	30.226	0
V_{16}	0.965	0	71.979	0	94.853	201.965	37.670	11.625	0
V_{17}	0.982	38.172	101.739	0	0	274.059	93.471	36.095	0
V_{18}	0.961	0	214.051	0	50.105	119.505	47.177	0	0
V_{19}	0.958	33.363	127.256	0	0	377.361	0	32.223	0
V_{20}	0.981	0	343.626	0	105.155	127.029	1.345	0	0
V_{21}	0.965	0.841	17.398	0	0	217.520	81.816	21.232	0
V_{25}	0.978	10.709	0	107.935	105.052	141.699	90.319	37.479	5.182

Source: Field Survey- 2014-15

One can notice from table 6 that in case of raising potato the DMUs of the middle land group are mostly inefficient because they have failed to use the two most inexpensive inputs namely home labour and organic manure wisely in comparison to other DMUs. In an overall inspection it is apparently clear that all most all the DMUs in case of potato production used their home labour callously. One reason that might be justified this callous composition of input use is the absent of other competitive crops that would be raised in the same agricultural monsoon. One may also in temptation put forward the argument of lower opportunity cost of home labour.

The efficient DMUs according to their ranks are V_{33}, V_1, V_2, V_3, V_{32}, V_5, V_{31}, V_7, V_8, V_9, V_{10}, V_{11}, V_{12}, V_{13}, V_{14}, V_{30}, V_{16} , V_{28}, V_{18}, V_{19}, V_{20}, V_{21}, V_{22}, V_{23}, V_{26}, and V_{25}.

TABLE 8: EFFICIENT DMUs BY RANKS (BORO PADDY)

Rank	DMU	Score
1 (1st)	V_{33}	1
1 (2nd)	V_1	1
1 (3rd)	V_2	1
1 (4th)	V_3	1
1 (5th)	V_{32}	1
1 (6th)	V_5	1

1 (7th)	V_{31}	1
1 (8th)	V_7	1
1 (9th)	V_8	1
1 (10th)	V_9	1
1 (11th)	V_{10}	1
1 (12th)	V_{11}	1
1 (13th)	V_{12}	1
1 (14th)	V_{13}	1
1 (15th)	V_{14}	1
1 (16th)	V_{30}	1
1 (17th)	V_{16}	1
1 (18th)	V_{28}	1
1 (19th)	V_{18}	1
1 (20th)	V_{19}	1
1 (21st)	V_{20}	1
1 (22nd)	V_{21}	1
1 (23rd)	V_{22}	1
1 (24th)	V_{23}	1
1 (25th)	V_{26}	1
1 (26th)	V_{25}	1

Source: Field Survey- 2014-15

The inefficient DMUs according to their ranks are V_{27}, V_4, V_6, V_{15}, V_{29}, V_{17}, and V_{24}

Table 9: INEFFICIENT DMUs BY RANKS (BORO PADDY)

Rank	DMU	Score
27	V_{27}	0.997531
28	V_4	0.996607
29	V_6	0.984669
30	V_{15}	0.978445
31	V_{29}	0.976736
32	V_{17}	0.974601
33	V_{24}	0.967014

Table 10: INEFFICIENT DMUs WITH REASONS (BORO PADDY)

DMU	Score	Excess DEP S-(1)	Excess HOMLA S-(2)	Excess HI LA S-(3)	Excess SEE S-(4)	Excess ORGM S-(5)	Excess INORGM S-(6)	Excess INSEC S-(7)	Excess IRRGWA S-(8)
V_4	0.996	0	34.662	0	7.897	0	5.219	17.661	26.084

V_6	0.984	0	0	24.170	14.105	0	0	0	0
V_{15}	0.978	83.637	29.097	66.156	0	0	6.935	8.241	0
V_{17}	0.974	0	0	76.046	18.764	0	0	0	0
V_{24}	0.967	0	0	152.468	1.887	0	0	11.643	89.962
V_{27}	0.997	55.274	0	55.893	7.399	26.799	0	49.621	1.596
V_{29}	0.976	51.423	0	32.607	0	0	0	6.842	0

Source: Field Survey- 2014-15

Thus it will be interesting if we concentrate our looking in the relative efficiency of the DMUs in Boro paddy production. This is given in table 8. What we have noted in the preceding paragraph that can be justified through this table. Here out of 33 DMUs, 26 DMUs have been appeared as relatively efficient DMUs. But what is important to note here is that irrespective of farm size the DMUs are efficient in raising the Boro paddy in this area economy. This outcome, in a large extent can express the reason of disappearance of tobacco cultivation in this area economy. The vertical size of the inefficient table 9 tells us the tale of Boro paddy production in a very significant manner. If we have a look on the same table then we see that out of 7 inefficient DMUs, three DMUs can be converted into efficient DMUs just a little bit wise use of inputs as revealed from table 10.

The most interesting point to be mentioned here is that there are some common DMUs in different land groups (V_3, V_7 in the land group "up to 2 Acres"; V_{10}, V_{11}, V_{13} in the land group "2-4 Acres" and V_{30}, V_{31}, V_{32}, V_{33} in the land group "4 + Acres") which are equally efficient in producing all these three crops in comparison to other DMUs in our sample economy. Our observation during the field survey reveals that the farmers of these common efficient DMUs possess the required minimum educational and technical knowledge for agricultural activities and they have the capacity of using good quality inputs required for a particular crop in time. Thus to make this grass-root economy efficient in all agricultural activities, particularly in case of Ravi Crops, the Official Agencies at the Block or District level should arrange proper seasonal training with the farmers regarding better and appropriate input combinations and at the same time easy and cheap credit facility should be extended to them.

CONCLUSION

The most interesting point to be mentioned here is that there are some common DMUs in different land groups (V_3, V_7 in the land group "up to 2 Acres"; V_{10}, V_{11}, V_{13} in the land group "2-4 Acres" and V_{30}, V_{31}, V_{32}, V_{33} in the land group "4 + Acres") which are equally efficient in producing all these three crops in comparison to other DMUs in our sample economy. Our observation during the field survey reveals that the farmers of these common efficient DMUs possess the required minimum educational and technical knowledge for agricultural activities and they have the capacity of using good quality inputs required for a particular crop in time. Thus to make this grass-root economy efficient in all agricultural activities, particularly in case of Ravi Crops, the Official Agencies at the Block or District level should arrange proper seasonal training with the farmers regarding the use of better and appropriate input combinations and at the same time easy and cheap credit facility should be extended to them.

R E F E R E N C E S:

1. Agarwalla and Singh ed. (1958): The Economics of Underdevelopment; Oxford University Press; Oxford.
2. Arrow, K. J. (1983): Social Choice and Justice; Harvard University Press; Cambridge.
3. Babu, P.K. (1988): Regional Planning in India; Chough Publications, Allahabad.
4. Banerjee, M. (1988): Planning in India; Oxford Publications and IBH, New Delhi.
5. Bardhan, P. K. (1984): Land, Labour and Rural Poverty; Oxford University Press; Delhi.

6. Bhaduri, A. (1984): The Structure of Backward Agriculture; MacMillan India Limited; New Delhi.

7. Bharadwaj, K. (1974): Production Condition in Indian Agriculture- A Study Based on Farm Management Surveys; Cambridge University Press, London.

8. Bharadwaj, K. (1974): Production Conditions in Indian Agriculture, London; Cambridge University Press, [Google Scholar].

9. Bhat, L. S. (1972): Regional Planning in India; Statistical Publishing Society; Calcutta.

10. Dhaia, B.S. ed. (1982): Development Planning Models, Vol. I & II; Inter- India Publications, New Delhi.

11. Gilling, D. (1975): Regional Planning and Social Change: A Responsive Approach; Saxon House, West Mead.

12. Heady, E.O. (1952): Economics of Agricultural production and Resource Use; Prentice Hall, International, Englewood Cliffs.

13. Rao, H. (1984): Regional Disparities and Development in India; Ashis Publishing House, New Delhi.

14. Charnes, A. Cooper, W. W., Lewin, A. Y. & Seiford, L. M. (Eds.) (1994): Data envelopment analysis:
Theory, methodology,and applications. Boston: Kluwer.

15. Chayanov, A.V. (1966): The Theory of Peasant Economy; Irwin Homewood.

16. Kar, S.C and Bhuimali, A (2014): Mainstreaming Indian Rural Economy and Policy, Abhijit Publishing House, New Delhi

17. Koopmans, T.C., (1951): Analysis of Production as an efficient combination of Activities; in T.C. Koopmans,
ed. Wiley, New York

18. Koopmans, T.C. (1957): Three Essays on the State of Economic Science; McGraw Hill Book Company,
New York

19. Rao, C. H. H. (1965): Agricultural Production Functions, Costs and Returns in India, London; Asia Publishing House. [Google Scholar]

   JOURNALS & ABSTRACTS:

1. Arrow, Chenery, Minhas and Solow (1962): "Capital and Labour Substitution and Economic Efficiency";
 Review in Economic Studies, XXIX.

2.Banker, R. D., Charnes, A., & Cooper, W. W. (1984): "Some models for estimating technical and scale inefficiencies
in data envelopment analysis";Management Science, 30(9), 1078- 1092

3. Bardhan, P.K.1973: "Size, Productivity and Returns to Scale: An Analysis of Farm-Level Data in Indian
Agriculture", Journal of Political Economy, 81(6) [Google Scholar]

4. Bharadwaj, K. (1974): "Notes on Farm Size and Productivity"; Economic and Political Weekly, March, 30.

5. 4. Bronfenbrenner, M. (1944): "Production Function: Cobb-Douglas Inter-firm and Intra-firm"; Econometrica.

5. Charnes, A., Cooper, W. W., & Rhodes, E. (1978): "Measuring the efficiency of decision making units";
European Journal of Operational Research, 2, 429- 444.

6. Chattopadhyay, M. and Rudra, A. (1976), "Size- Productivity Revisited", Economic and Political Weekly, 11(39) Review
 of Agriculture) [Google Scholar]

7. Cobb, C. W. And Douglas, P.H. (1928): "A Theory of Production"; American Economic Review, March.

8. Koopmans, T.C. (1951): "Efficient Allocation of Resources"; Econometrica.

9. Rudra, A. (1968a): "Farm Size and Yield per Acre", Economic and Political Weekly, 3 Special Number [Google Scholar]