A STATISTICAL STUDY OF SCHULTZIAN THESIS CONCERNING MISALLOCATION RESOURCES IN TRADITIONAL AND NONTRADITIONAL AGRICULTURE

BY

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I. INTRODUCTION

According to T.W. Schultz, resource allocation is perfect in a traditional agriculture and it is only in a non-traditional agriculture that imperfections in resources allocation are likely to be noticed. Or, in his own words, Schultz comments :—paradoxical as it may seem, farmers in traditional agriculture are generally more efficient by strict economic standards than farmers in technically advanced countries in using the particular collection of land, labour and material reproducible capital that they have at their disposal [27].

Schultz quotes the studies conducted by Hopper [14] and Tax [32] to support his thesis that in a traditional agriculture profits of the farmers are maximum.

Schultz's thesis has been disputed by many Economists, both at the theoritical level as well as on the empirical plane. For instance, Shubik [29], Askari and Cummings [3], Feder [11], Lipton [19] [20], Gasson [12], Kahlon and Sharma [18], Mandal and Ghosh [22] and quite a few others have pointed out that many factors, other than profit, influence resources allocation in agriculture. According to Dhillon and Anderson [9] farmers maximise expected utility rather than profit. Adams [2] while agreeing with Schultz that a farmer in a traditional agriculture is rational, asserts that rationality need not mean optimality. Dunn [10], however, is not sure sure if the farmers in a traditional agriculture act rationally. Bhagwati and Chakravarti [5], Nowshirwani [24], and Rudra [25] have criticised the way the production function approach has been used by David Hopper in his study—the study that Schultz quotes to substantiate his views. Bologh [6] and Beckford [4] point to the scanty evidence that Schultz has used to support his assertion. Bottomly [7] refers to the imperfections in the factor market which cause misallocation of resources in a traditional agriculture. Lipton [20] feels that the correctness of the Schultzian thesis is dependent upon an untenable assumption of static environment. According to Shah [28], Schultzian assertion did not go beyond the stage of hypothesis.

Empirically, too, Schultz's assertion of perfect resources allocation in a traditional agriculture has failed to find confirmation in the studies conducted by quite a few research workers. Heady [13], Naik [23], Achari [1], Desai [8], Malya [21], Saini [26], Kahlon and Johl [16] [17], Jai Krishna [15] and Soni [30] [31], have detected misaltocation of resources in traditional agriculture in their studies covering different regions of India.

No doubt, the above cited authors are able to prove that misallocation of resources exists in a traditional agriculture but the major flaw in their empirical studies is that these are based upon a one-point data. The Schultzian thesis could still be claimed to be partially correct at the operational level if it were established that the degree of misallocation is higher in the non-traditional agriculture than that in traditional agriculture. This is what Schultz implies when he says :— "On the basis of strict allocation test, the farmers (in traditional agriculture) are more efficient than the farmers in most of the modern agriculture because the latter are in a state of disequilibrium..." [27]. A comparative study of resource allocation, at two points of time—one representing the era of traditional agriculture and the other the non-traditional agriculture—would, therefore, be necessary to confirm or reject the Schultzian thesis completely.

The study in the sections that follow is aimed probing into this Schultzian thesis, It examines the resources allocation in agriculture at two points of time namely 1956-57 and 1969-70 in Fazilka-Mukatsar region of the Punjab State. Whereas the year 1956-57 could be regarded as a period of traditional agriculture, the year 1969-70 could be that of non-traditional agriculture.

2. CERTAIN PRELIMINARIES :

We outline below certain preliminaries, which are very essential in the study of the problem in hand.

(*i*) *The Data and Sources*: The data were collected by random sample method by the Economic and Statistical Organisation (ESO) of Punjab through cost accounting method for the two years. Whereas the data for 1956-57 were originally collected by the (ESO) for the farm management studies, the data for 1969-70 were originally collected for (a) Farm Management studies, and (b) for the study of Economics of Tractor Cultivation and high Yielding Varieties. The data collected for the two studies in 1969-70 were utilized for this present study. Complete input-output data for 50 and 47 farms were studied for years 1956-57 and 1969-70 respectively.

(*ii*) *The Individual V/S Synthetic Farms* : A study of misallocation of resources obviously implies a study of the departure of the actual allocation of resources from the optimum allocation of resources. There could be two alternative approaches for finding out the optimum allocation for the region as a whole. We could either study the misallocation of resources by studying the misallocation on each individual farm and then averaging the results or we could first of all evolve a synthetic farm and then study the misallocation of such a farm. In the present study we have found worth-while to adopt the latter approach.

Further, in order that our study is more meaningful for comparison purposes, we have evolved the following groupings of Synthetic farm situations :—

(I)	Small farms (1956-57)	*vs.*	Small farms (1969-70)
(II)	Large farms (1956-57)	*vs.*	Large farms (1969-70)
(III)	Large non-tractorised farms (1956-57)	*vs.*	Large tractorised farms (1969-70)
(VI)	Large bullock cultivated farms (1956-57)	*vs.*	Large bullock cultivated farms (1969-70)
(V)	All farms (1956-57)	*vs.*	All farms (1969-70)

Note : (*a*) Median farm has been used as the dividing line for determining the groups of small and large farms for each point of time.

(*b*) Large farms in 1956-57 were all bullock cultivated. Some of the large farms in 1969-70 were bullock cultivated while others were tractorised. We divided the large farms in 1969-70 in two categories namely, tractorised farms and bullock cultiveted farms. Against each farm in the 'tractorised' and 'Bullock cultivated' group in the year 1969-70 we selected farm of matching size out of large farms in 1956-57.

(iii) The Linear Programming Model : As remarked earlier, the study of misallocation of resources obviously implies a study of the departure of the actual allocation of resources from the optimum allocation of resources and to determine the latter, the Linear Programming technique has been employed.

A little explanation regarding the objective function, resource constraints and activities is desirable before we give the final Linear Programming model.

The Objective Function : Profit* has been taken as the objective function for the present study.

Let Z be the profit, so that

$$Z=\sum_{i=1}^{n}\left(P_i-\frac{1}{3}\,P_i-V_i\right)Q_i-M$$

Where

P_i= the gross value per acre of the ith crop calculated at average price prevailing in the previous years (crop have been evluated at the previous years average prices because these are the prices which influence the resource allocation for the succeeding year to the maximum extent).

Q_i= the area in acres under the ith crop;

V_i= the cost of the variable inputs (excluding rent) used per acre for producing the ith crop;

M= the total fixed cost.

A deductions of $\frac{1}{3}\,p_i$ from p_i has been made for the rent. This is based upon the rate (share of gross produce) that has been fixed by the Panjab Government under the Puujab Security of land Tenure Act, 1953,

Resource Canstraints : Land, Labour (actually available during the two peak seasons, namely, 15th April to 15th June and 15th Saptember to 15th November), water supply (Actually available

* In addition to the objective function 'profit' the authors have considered two more objective functions, namely, the value of gross-output and value added. The results based upon these two objective functions will also be submitted in a subsequent paper.

during the months of September, October and November), and cash (representing the actual or imputed expenditure on variable inputs) have been used as resource constraints.

Activities : The non-nagativity constraints on the activities on a synthetic farm have been modified as follows :—

(1) area under both Kharif and Rabi fodder has been taken to be fixed. This has been warranted by the fact that fodder is a commdoity required in a fixed amount for daily consumption, no matter whather or not the production plan is the optimum one;

(2) the acreage under some crops (those together covering less than 2% of the total farm area) has been so insignificant that we have assumed their values to be zero for the model;

(3) the area under sugarcane recurring (*i.e.*, the sugarcane crop in the previous year allowed to give the second crop in the current year) hrs been considered to have remained uncharged even under the final plan. Obviously, this area could neither be increased nor decreased even after re-allocation of resources in the current year.

The final Model : The final Linear Programming Model emerges as follows :—

$$\text{Max} \sum_{i=1}^{n} (\tfrac{2}{3}\, p_i - V_i)\, Q_i - M$$

subject to the followtng constraints :

Activities Constraints :

$Q_i > 0, \; i = 1, \ldots\ldots n$

$Q_{n-2} = k_1$ (constant), for Kharif fodder

$Q_{n-1} = k_2$ (constant), for Rabi fodder

$Q_n \; = k_3$ (constant), for sugarcane (recurring)

Resource Constraints :

Land

$$L_{j1}\, Q_1 + L_{j2} Q_2 \leftrightarrow L_{jn} Q_n \leqslant L_j, \; J = 1,\, 2 \ldots\ldots\ldots n$$

where

$L_{ji} = 1$ for $i = j$, n and also for each i competing with $j, = 0$ for each i supplementry to j, and

L_j is the area of the farm (in acres) suitable for producing jth crop.

Irrigation

$$W_{1t}Q_1 + W_{2t}Q_2 + \leftrightarrow W_{nt}Q_n \leqslant I_t$$

where W_{it} ($i=1, \ldots\ldots, n$) is the hours of watering acutually utilized per acre for the ith crop in period t (t=peak period : 1 (September), 2(October) and 3(November), and I_t is the total hours of irrigation which were actually used on the synthetic farm in period t.

Labour

$$m_{1t}Q_1 + m_{2t}Q_2 \leftrightarrow m_{nt}Q_n \leqslant N_t$$

where m_{it} ($i=1, 2, \ldots\ldots, n$) is the mandays used per acre for the ith crop in period t;

$t=1$ (April-June), 2(September-November), and

N_t is the total labour (in mandays) actually used on the given synthetic farm in the peak period t.

Cash

$$V_1Q_1 + V_2Q_2 \leftrightarrow V_nQ_n \leqslant V_0$$

where V_i ($i=1, 2, \ldots\ldots n$) is the amount of cash (representing all variable costs excluding rent) used per acre to produce the ith crop; and V_0 is the total cash actually available on the synthetic farm for growing all the crops.

3. Study of the Absolute Misallocation :

Optimum plan for each synthetic farm situation has been found with the Linear Programming technique. The value of objective function under optimum plan and its value under corresponding actual plan for various form situations has been shown in Table I.

As indicated earlier, both the actual as well as the optimum values have been calculated at the average prices prevailing in the previous year.

Table I, reveals that the optimum plans for every synthetic farm situation are different from the corresponding actual plans, thus iudicating that the resources allocation is not perfect at either of the two points of time. Schultzian thesis that resource allocation is perfect in traditional agriculture (i.e. in 1956-57) is thus disproved. This however, is not all. It remains to be established that misallocation of resources in the non-traditional agriculture is not more than what it is in the traditional agriculture.

TABLE—1

Actual and Optimum Value of the Objective Function "Profit" for Different Synthetic Farm Situations.

Synthetic farms situation	*1956-57*		*1969-70*	
	Actual Profit (Rs.)	*Optimum Profit (Rs.)*	*Actual Profit (Rs.)*	*Optimum Profit (Rs.)*
I. Small farms	−153	9	487	791
II. Large farms	447	827	2403	4365
III. Large non-tractorised farms (1956-57)/Large tractorised farms (1969-70)	338	778	1637	5996
IV. Large bullock-cultivated farms	211	543	3536	5050
V. All farms	147	429	1466	2820

4. Study of Degree of Misallocation, Measures and Statistical Test Results :

We now proceed to examine as to what extent the misallocation of resources in 1969-70 is different from that in 1956-57.

The Three Measures Applied for Comparative Evaluation : Before we are able to compare the misallocation of resources at two points of time, it is necessary to explain the measures that are used for this purpose. The three measures are proposed as below -

(*i*) *Proportionnal Maximand Differences-I* : Misallocation of resources on a farm, at a point of time, can easily be know by finding out the difference between the optimum value of the objective function and its actual value. However, such a difference cannot be considered an appropriate measure of misallocation at two points of time. At a particular point of time, the difference is largely influenced by the factors : (a) misallocation proper, (b) the prices of agricultural crops, and (c) the yield per acre of these crops. A higher price level of crops as well as their higher yield will increase this difference even though both the actual as well as the optimum plans for resource use for a given farm remain unchanged. Accordingly, if a comparative study of misallocation proper at two points of time has to be made with the help of this difference, it must be made free from the effects of changes in crop prices and crop yield. In our view, the following measure,' to be called hereafter the Proportional Maximand Difference-I (or, simply PMD-I) could achieve this objective :

$$\text{PMD-I} = \frac{\text{(Optimum value of the objective function) minus (the actual value of the objective function)}}{\text{Optimum value of the objective function.}}$$

(*ii*) *Proportional Maximand Differenee-II* : We could in fact think of a variant of the above measure. Instead of dividing the difference between the optimum and the actual value of objective function by the optimum value of the objective function we could use the total cost of cultivation (value of total variable and fixed inputs actually used) as the denominator. We would call this measure as Proportional Maximand Difference-II (or, simply PMD-II) and define it as follows :

$$\text{PMD-II} = \frac{\text{(Optimum value of the objective function) minus (Actual value of the objective function)}}{\text{Total cost of cultivation}}$$

A higher value of PMD-I or PMD-II will indicate a higher degree of misallocation.

(*iii*) *Relative Change in the Area Under Major Crops* : The above two measures examine the degree of misallocation in terms of change in profit-the objective function. There is yet another way in which we can look at the difference in the actual and the optimum plan. It is in terms of crops produced. Optimisation of resource allocation implies dropping of minor crops from the production plan and their substitution by the remaining crops. The crops that still find a place in the optimum plan may be called major crops (as against the minor crops that are dropped from the production plan on optimisation). A reliable idea about the misallocation of resources from the structural point of view can be had by measuring the relative change in the area under major crops after optimisation. We designate this measure as RCAMC and define it as follows :

$$\text{RCAMC}=\frac{\text{Increase in the area under major crops on optimisation}}{\text{Area under major crops in the actual plan.}}$$

A higher value of RCAMC will indicate a higher degree of misallocation.

Statistical Test Procedure : Values for the above three measures for each synthetic farm situation at each point of time would obviously be in the form of ratios. Ratios pertaining to a particular measure for two points of time for each of the given synthetic farm situation can be compared and tested for the significance of their difference. The usual test of significance i.e. one-tailed test for difference of proportions i.e Z test (called normal-deviate-test) in case of large samples and t-test in case of small samples can be applied. Lastly, each difference can be tested at 5% level of significance.

Application of Measures and Statistical Analysis : The paragraphs that follow give the value of various measures and the statistical results of comparisons for different farm situations.

Use of PMD-I's : The following Table-2 shows the PMD-I's for various synthetic farm situations for the two years.

TABLE—2

PDM-I's For Various Synthetic Farm Situations for the years 1956-57 and 1969-70

Synthetic Farm Situation	*1956-57*	*1969-70*
I. Small farms	1.00 (n=25)	0.3843 (n=23)
II. Large farms	0,4594 (n=25)	0.4495 (n=25)
III. Large non-tractorised farms 1956-57/Large tractorised farms 1969-70	0.5656 (n=12)	0.7269 (n=12)
IV. Large bullock-cultivated farms	0.6114 (n=11)	0.2998 (n=11)
V. All farms	0.6573 (n=50)	0.4801 (n=47)

Note: 1. n s in the Table 2 as well as in the tables, that follow indicate the number of farms represented by a synthetic farm situation.

2. There were actually 13 Tractorised farms in 1969-70. However one farm was ignored because the farm of the matching size in the data for the year 1956-57 could not be found.

3. It may be pointed out that in Table-1 the entry against syhthetic farm situation-I for the year 1956-57 for actual profit is −153 which infact is a disturbing factor. For the convenience of applying the statistical procedure. we, therefore, have assumed that the actual profit is equal to zero. This fact has been used for finding PMD-I for the synthetic farm situation-I for the year 1956-57 in Table-2.

The tests of significance reveal that

(*a*) misallocation in 1969-70 is significantly lower than that in 1956-57 for small Farms ;

(*b*) difference in misallocation is insignificant for the farm situations representing Large Farms, Large Tractorised Farms and Large Bullock-Cultivated Farms ; and

(*c*) misallocation in 1969-70 is significantly lower than that in 1956-57 for the synthetic farm situation V (All Farms). As the difference in misallocation for all synthetic farm situations based on large farms or their sub-groups (i.e. synthetic farm situations-II, III and IV) is insignificant it is reasonable to conclude that results for synthetic farm situation V (All Farms) are in fact a reflection of the results of synthetic farm situation-I (Small Farms.)

Use of PMD-II : Table 3 gives below the values of PMD-II's for Various Synthetic Farm Situations for the two years :

TABLE—3

PMD-II's For Various Synthetic Farm Situations For the Years 1956-57 and 1969-70

Synthetic Farm Situations	*1956-57*	*1969-70*
I. Small farms	0.1262 (n=25)	0.0550 (n=23)
II. Large farms	0.1112 (n=25)	0.1136 (n=24)
III. Large Non-tractorised farms 1956-57./Large tractorised farms 1969-70	0.1074 (n=12)	0.2311 (n=12)
IV. Large bullock-cultivated farms	0.0930 (n=11)	0.1140 (n=11)
V. All farms	0.1199 (n=50)	0.1175 (n=47)

Tests of significance at 5% level reveal that no two corresponding PMD-II's are significantly different from each other for any synthetic farm situation. In other words, if there is decline in misallocation it has been found to be statistically non-significant ; and if there is any increase in misallocation it is also non-significant.

Use of RCAMC : Table 4 gives following values of RCAMC's for various synthetic farm situations for the two years :

TABLE--4

RCAMC's For Various Synthetic Farm Situations For the Years 1956-57 and 1969-70

Synthetic Farm Situations	*1956-57*	*1969-70*
I. Small farms	0.8586 (n=25)	0.2055 (n=23)
II. Large farms	0.4795 (n=25)	0.2324 (n=24)
III. Large non-tractorised farms 1956-57/Large tractorised farms 1969-70	0.4308 (n=12)	0.2038 (n=12)
IV. Large bullock-cultivated farms	0.2235 (n=11)	0.4646 (n=11)
V. All farms	0.6358 (n=50)	0.3352 (n=47)

Following results regarding misallocation are revealed by the statistical tests -

(*a*) Misallocation for each of the Synthetic Farms representing Small Farms, Large Farms, and All Farms in 1969-70 is significantly lower than that in 1956-57 ;

(*b*) Misallocation for each of the synthetic farms representing the Non-tractorised/Tractorised Farms and Large Bullock-Cultivated Farms in 1969-70 is not significantly different from that in 1956-57.

The Over-All Results

The following table gives a birds eye view of the conclusions arrived at statistically with the help of the three measures of misallocation for different farm situations :

TABLE—5

Summary of the Statistical Results Yielded by Measures PMD-I, PMD-II andRCAMC at 5% Level of Significance – Regarding changes in Misallocation at Two Points of Time.

Synthetic Farm Situations	*PMD-I*	*PMD-II*	*RCAMC*	*Remarks*
I. Small farms	Significant decline	Non-significant decline	Significant decline	Over all trend towards decline
II. Large farms	Non-significant decline	Non-significant increase	Significant decline	—do—
III. Large Non-tractorised farms 1956-57/ Large tractorised farms 1969-70	Non-significant increase	Non-significant increase	Non-significant decline	Change not significant
IV. Large bullock-cultivated farms	Non-significant decline	Non-significant increase	Non-significant in crease	—do—
V. All farms	Significant decline	Non-significant decline	Significant decline	Over all trend towards decline

A perusal of the above table reveals the following facts :

(*i*) that the three measures of misallocation yield similar findings in case of Synthetic Farm Situation-III (Non-tractorised/Tractorised farms) and Synthetic Farm Situation-IV (Large Bullock Cultivated farms). All the three measures show that for these two Synthetic Farm situations the misallocation has neither increased nor decreased significantly with the passage of time.

(*ii*) that for Synthetic Farm situations I, II and V, if there is a rise in misallocation, it is statistically non-significant, and if there is a decline in misallocation, it is significant in some cases and non-significant in others.

On the basis of the above two facts, it may now be safely concluded that for any farm situation there is no evidence of significant rise in misallocation from one point of time representing (traditional agriculture) to another point of time (representing non-traditional agriculture).

We have thus found the missing part of the answer to our query. Misallocation has not increased as the agriculture becomes non-traditional in character. In some cases, infact, it has shown a decline. And there are reasons to believe that such a decline can occur in this part of India. The new technology has led to either the emergence of or increase in marketable surplus on various farms. This has pushed them into the product market. The use of inputs necessitated by the new Agricultural technology has pushed them into the factor market also. The farms have thus been brought closer to the market. The impact of this change on resource allocation is relatively more pronounced in case of Small farms because they were earlier completely off the market. The new techniques have not only brought them additional profits, but also have made them profit-conscious. Improved transport system and improved marketing facilities have also strengthened the business motive of the farmers in general. Higher educational standard has helped the farmers in taking right decisions. Reduction in uncertainly in yield through improved irrigation facilities, through more liberal use of insecticides and pesticides, and in price uncerteintly through the policy of support prices have also led to improved allocative decisions.

5. Conclusion :

The preceding analysis leads us to two important conclusions. *Firstly,* resource allocation is not perfect in traditional agriculture. *Secondly*, as the traditional agriculture is transformed with the use of improved inputs, the resource allocation further improves.

With the use of improved inputs, misallocation does not increase. Infact, it declines in some cases.

Both of these conclusions are against the Schultzian hypothesis regarding perfect allocation of resources in traditional agriculture. Whereas the first conclusion directly disproves the Schultzian hypothesis that resource allocation is perfect in the traditional agriculture, the second does so indirectly by revealing that resource allocation becomes better and not worse (as implied by the Schultzian hypothesis) when agriculture in an economy starts using non-traditional inputs and is no longer traditional as defined by Schultz.

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