RESOURCE ALLOCATION IN TRADITIONAL AGRICULTURE

A Case Study of West Bengal in the Mid-Fifties

By

Sulata Rudra

A PLAN B PAPER

submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

1970

RESOURCE ALLOCATION IN TRADITIONAL AGRICULTURE

A Case Study of West Bengal in the Mid-Fifties

Sulata Rudra

Agricultural Economics 882

Introduction

An era has come when the most ancient industry, namely, agriculture, is beginning to be transformed in the underdeveloped countries of the world. Changes are taking different directions in different places with different rates of growth. However, the "traditional agriculture" characterised by age old technique of production is not a myth of the past. There are vast agricultural areas, where even though modernisation has started, the rate of growth of agriculture is not fast enough to wipe away some of the basic characteristics of "traditional agriculture."

The present study is an exploration of resource allocation in traditional agriculture and employs linear programming technique to answer the following questions: (1) how far do we find conformity between actual resource allocation and optimal resource allocation given the constraints under which the traditional agriculture is operating at a particular point of time? (2) Which inputs act as limiting factors under the existing resource availabilities? (3) How fully are all resources presently engaged in farming activities or remaining on farm utilised, assuming that the farms are trying to maximise return to fixed resources, through crop production activities? (4) What is the time distribution of the surplus resources? is it essentially seasonal or permanent in nature? (5) Whether part of the

resources presently engaged in farming activities can be removed without affecting the level of agricultural production?

The focus of attention of the present model is primarily on the crop production activities though some other activities have been included in the model, depending on their impact on crop production activities within a single production period. Six crops have been considered for a single production period consisting of two crop seasons, Kharif (Summer) and Rabi (Winter). The reasons for these limitations are to avoid greater complexities and the need for making arbitrary assumptions, in view of limited information available. Besides, under traditional agriculture the family farm has limited opportunity of switching over to other crop and non-crop activities when technology and institutions are held constant.

The purpose in view is to examine the nature of resource allocation and resource utilisation for a single production period, assuming that crop production is the main activity of the farms and resources currently available for such activities are essentially constant. This precludes intersectoral flow of resources, which can be studied only with the knowledge of the alternative opportunities available for off-farm resource use. And research on the particulars of off-farm utilisation potentials of resources, presently employed in farming, is extremely limited and in fact, such potentials will depend upon the peculiarities of the economy.

Within the limits of the partial equilibrium analysis the model investigates important issues that have been a pivot of interest to researchers engaged in studying agricultural development. Schultz claimed that there are relatively few inefficiencies in traditional agriculture.[1] According to him, allocation of resources among enterprises is optimum. Hopper, by means of production function approach, showed that marginal value product is equal to marginal factor cost in traditional agriculture which implies optimum allocation of resources.[2] On the other hand, Rogers, in an analysis of world-wide subculture of peasantry makes psychological traits such as fatalism, limited aspiration, lack of deferred gratification, etc., responsible for the prevailing conditions of the peasants.[3]

These social scientists, Hopper and Schultz on the one hand and Rogers on the other, are apparently dealing with two different aspects--traditional agriculture and peasant subculture. But so far as general impression is concerned one depicts a picture of rational farmers making best use of limited resources. Another designates farmers by mental

---

[1]Schultz: Transforming Traditional Agriculture. p. 37.

[2]Hopper, W. D.: The Economic Organisation of a Village in North Central India.

[3]Rogers: Modernisation Among Peasants - the Impact of Communications. p. 25.

atrributes all of which have negative implications for
economic progress. One places emphasis on resource con-
straint as an explanation of the present state of tradi-
tional agriculture; the other finds psychological factors
pertaining to the peasants responsible for such condition,
irrespective of availability of resources and institutions.

Further Rogers quotes from Foster, "The Anglo-Saxon
virtues of hard work and thrift seen as leading to economic
success are meaningless in peasant society."[1] This state-
ment ignores the fact that forced idleness or in other words,
non-utilisation of resources is possible even under optimum
resource allocation.

There are major controversies on other points such
as whether marginal value product of labour is zero in the
densely populated underdeveloped agriculture or, if there
is labour surplus, whether that surplus is removable or
not, i.e., whether the peak work load can be carried, if a
part of the present work force available on farm is removed
to other sectors. The present study is an empirical approach
to all these issues of theoretical significance and practical
relevance. The scope of the study is of course limited by
being a case study, but at the same time, it is representative
of the fundamental characteristics of traditional agriculture.
Besides, it demonstrates the use of one of the production
economics techniques to examine some of the open questions
of development literature.

---

[1]Rogers: Modernisation Among Peasants. p. 34.

The analysis is based on "Farm Management Study" data of two hundred farms for the period 1954-1955, 1955-56 and 1956-1957. The two hundred farms are distributed over two districts, Hooghly and 24 Parganas in West Bengal, India. The two districts taken together constitute one soil climate type complex of the delta region of West Bengal. Hooghly is a little more advanced in agriculture than average West Bengal, while 24 Parganas is a little more backward than the average. Therefore, the average of the two districts might be taken as representative of the state of West Bengal.

The paper has been divided into the following sections:

(1) Characteristic features of agriculture of the region under study.

(2) The analytical framework.

(3) Tableau Resolved.

(4) New dimensions - indications for further research.

(5) Conclusions.

The first section provides background information relevant for designing the model. The second section discusses the nature of the model and gives details of specifications with respect to activities constraints, coefficients and objective functions. The third section describes and interprets the results of the optimum solution and discusses the limitations of the model and the impact of such limitations on the optimum solution. The fourth section indicates the different problem areas that can be investigated, by extending

the present model in the respective directions. The last
section brings out the implications of the major findings
and discusses the usefulness of the present type of approach
in locating the crucial points where a change in resource
allocation of long term nature will be most profitable.

Characteristic Features of the Agriculture
of the Region under Study

The nature of agriculture of the region for mid-fifties reveals mostly the features of "traditional agriculture" characterised by a given technology.[1] The modern agricultural inputs are conspicuous by their absence. Consequently yield per acre is low. Land and labour are the two major inputs of production.[2] Very little change takes place in the amount of capital resources on a year-to-year basis. This is especially true for the smaller farms depending on subsistence type of farming. One of the major activities of the farm, namely, purchase of land, is often guided by the motivation of social status, expectation of higher value of land in the future, desire for security, etc. Selling of land is done sometimes to meet necessary lump sum expenses for consumption such as education, wedding, sickness, travel, etc. Similarly, leasing in and out of land is often guided by institutional arrangements, personal contracts, etc. There are certain arrangements made on long-term basis, sometimes for the lifetime of the tenant for leasing in of land--these are not subject to market fluctuations. Large farmers often lease out land so as to obtain the necessary labour from the small farmers in time of need--the small farmers might lease

---

[1]Attributes of Traditional Agriculture--Schultz - Transforming Traditional Agriculture. Page 30.

[2]Appendix 1. Table 4.

in land to have relationship with the well-to-do neighbors whom he can fall upon for contingency. However, leasing is done more on a commercial basis, since the passing of the "Tenancy Reform Act" in the early fifties. As the tenants can develop certain rights on land if they cultivate it continuously for several years, land is leased out generally on a year-to-year basis. Similar type of institutional arrangements can be observed in the case of other factors of production.

Crop production is by far the most important activity of the farm. Of the six major crops of the region, Aman Paddy is of overwhelming importance. About 71.42 percent of total gross area is devoted to Aman Paddy.[1]

Activities of the farm are primarily confined to crop production and the average size of farm is as low as 2.89 acres, average net area sown is about 83.94 percent of the total cultivable area which indicates lack of double cropping. Some additional confirmation is available from Table 2 and Table 3 which give average net area sown, average irrigated area per farm and intensity of cropping figures respectively.[2]

Human labour constitutes 47 percent of total inputs. Bulk of the expenditure is on human labour and bullock labour. Expenditures on seeds, manures and implements are negligible.

---

[1] Appendix 1.   Table 1.

[2] Appendix 1.

Cash expenditures are roughly one-fourth of the total expenditure. The inputs are essentially of traditional nature. The major items entering into owned capital are land and buildings. Table 4 and Table 5 represent distribution of expenditure on different inputs and distribution of cash and non-cash expenditure respectively.

Proportion of irrigated area to total cultivable area is on an average about 12.6 percent. This indicates one of the limitations on double cropping. However, the two districts show very different type of trend in this respect. Distribution of irrigated area by size group of holdings in each district is given in Table 2.[1]

The total available farm labour in a year is calculated on the basis of eight hours a day and can conveniently be divided into three categories, namely, farm, non-farm and unemployed. Farm labour includes the labour spent on crop production and other farm work, hired out labour and labour given gratis or exchanged for farm work. Non-farm work includes labour spent on business, social and family work. The labour that could not be used in either farm or non-farm work due to sickness or lack of opportunity of its utilization is called unemployed. Table 6 provides data regarding farm, non-farm and unemployed labour.[2]

Nearly one-third of the labour remains unemployed and the rest is utilized for farm and non-farm purposes in almost

---

[1]Appendix 1.

[2]Appendix 1.

equal proportions. Distribution of these three categories show more or less the same pattern for the different size group of holdings. This way of summarizing the data portrays the supply side of the picture.

Bullock labour is also an important input. The maintenance of draught cattle is considered essential for the efficient operation of a farm since it is the only source of draught power and producer of farm manure under traditional agriculture. However, 36 percent of the farms do not possess any draught cattle at all. They have to depend wholly on hired bullocks or bullocks taken in exchange labour. Though the minimum unit of cattle requirement is a pair of cattle, nine percent of the sample farms own only one cattle each. Thus 45 percent of the farms lack wholly or partly the only source of draught power used for cultivation. On the other hand, after maintaining the bullocks throughout the year the farmer can utilize only 14 percent of the available bullock labour in farm and non-farm activities. Table 7 gives the proportion of bullock labour used and the proportion remaining unemployed.[1]

In the operation of the family farm, the production and consumption units are closely associated with each other. A major part of the input is owned input, not purchased by the farmer. Under such circumstances it becomes difficult

---

[1]Appendix 1

to specify what the farm wants to maximize. Tables 8A, 8B, 8C, 8D and 8E[1] give the profit and loss per acre on the basis of four concepts of cost. The four concepts are as follows:

Cost A_1: Hired human labour, owned and hired bullock labour, seed and manure, (farm produced and purchased), irrigation charges, interest on crop loans, depreciation of implements and other charges.

Cost A_2: Cost A_1 plus rent paid on land taken on lease.

Cost B: Cost A_2 plus rent on owned land and interest on owned capital at the rate of 3 percent per annum.

Cost C: Cost B plus the imputed value of family labour.

If we consider the profit and loss* figures given in these tables, Aman paddy would appear as the only crop of the region that consistently shows profit on the average. The amount of profit, however, is quite small.

Pulses show negative return* for almost all size group of holdings. Still considerable proportion of land is devoted to this crop. This is because of the fact that cultivation of this crop generally involves very little cash expenditure, the way it is done and land will lie fallow in Rabi season (winter) otherwise, because the other winter crop, potato, will need irrigation and will involve considerable amount of expenditure for its production. Besides it helps increasing soil fertility through nitrogen deposits.

---

[1]Appendix 2

*Net return over cost C.

Cultivation of potato involves high cost of production and the amount of loss following from it is also quite high except for two size group of holdings. These facts indicate that factors other than profit as such are important in the production decision. This again is due to the peculiarities involved in production under family farm systems, which are commercialized only to a limited extent.

The Analytical Framework

An attempt has been made to fit a linear programming model to find out optimum allocation of resources to (1) the production of six different crops, which are considered as major activities of the farm; (2) hiring of human labour, hiring of bullock labour, leasing in of land, which are directly related to the production of different crops, and (3) leasing out of land and borrowing and lending, which have an impact on crop production activity.

Optimum allocation will be worked out for each of the eight different size groups of holdings separately. The underlying implication is to accept the average of each size group as a representative farm of that size group. This type of aggregation might become unrealistic if the constrains and coefficients for each farm within the same size group are not the same. In the present study the districts show different coefficients of production and different yield rates. Therefore, taking acreage adjusted for fertility would have been more scientific than taking mere physical acreage, but data are found inadequate for this type of analysis.[1]

Secondly, the resource allocation problem is to be worked out for each district taken separately. This part of the analysis will relate to hypothetical units, one for each district, which represents the chracteristics, consisting of

---

[1]A. M. Khusro, "Returns to Scale in Indian Agriculture." Indian Journal of Agricultural Economics July-Dec., 1964, pp. 51-80.
 B. Sen: Farm Productivity and Soil Fertility in Indian Farm. Indian Journal of Agricultural Economics, 1967, p. 73.

the average of the respective characteristics of all farms within the respective area. The purpose is to see whether the pictures emerging for two districts are essentially different or not. The need for this type of aggregation arises because data are not available for each district separately when breakdown is made by size group of holdings. A more scientific way of doing it would have been to take a representative farm or a typical farm from the district but this has not been possible because of unavailability of data. So the possibility remains that the means might be influenced by peculiarities of some big farm because averaging is done on per acre basis.

The model will be discussed in the rest of this section under the sub headings of (1) Activities, (2) Constraints, (3) Coefficients, and (4) Objective function.

Activities

The linear programming model set up for the present purpose is a partial one, in the sense that it focuses attention primarily on crop production activities of the farm and secondly it relates to one single production period and assumes a part of the capital to be fixed instead of allowing for the acquisition and salvage of that part, depending on marginal value product and its relation to acquisition and salvage prices. This type of restrictions had to be imposed because of lack of essential information necessary to build up a more comprehensive model. Since crop production, leasing of land and borrowing and lending are three important areas of operation of the family farm, in the set-up under study, only these three

aspects have been taken into account in the present model. Besides, these three are closely interrelated to each other. Hiring in of human labour and hiring in of bullock labour for crop production in twelve different periods have been considered in the model. Hiring out of human labour and hiring out of bullock labour have not been taken care of in the model. This is due to various reasons. These two factors of production can be hired out both to the farming sector and to the non-farming sector. Hiring out of labour to the farming sector is of very limited nature under actual circumstances which indicates limited demand within the sector for these inputs. About 13 percent of human labour and two percent of bullock labour were hired out on an average for the present Farm Management Study data.

For human labour it is assumed that demand can be met from the agricultural labourers who constitute approximately twenty-two percent of the total agricultural population, and since most of them are landless, it is likely that they will offer their services at a lower wage rate than the farmers having their own farm. Therefore, there is no logical inconsistency in the model with respect to human labour when it allows for hiring in of human labour without any amount of hiring out. Moreover, the trial run showed absolutely no hiring in of human labour for any of the different size groups of holdings, therefore, the need is not felt to allow hiring out to the farming sector itself because for optimum solution, no one would be hiring in, while the programme will go on hiring out labour, since the marginal product of surplus labour on farm is zero. Secondly, unlimited amount of leasing

land in was allowed in one of the trial runs, even then the programme did not hire any human labour.

This of course does not preclude hiring out of human labour for non-farm activities. This needs a little investigation. The present data show that about thirty-five percent of the total labour force of the farm family is engaged in non-farm work. This percentage has been assumed as fixed for the present purpose. The theoretical reason for such assumption is that, since no more than thirty-five percent moved to the non-farm activities, even when thirty-two percent of the farm family labour remained unemployed, this must have been either due to lack of demand in the non-farm sector or that the transfer cost must have been higher than the wage rate prevailing in the non-farm sector. It is a difficult task to determine intersectoral flow of human labour when no information is available on non-farm wage rate, non-farm demand for labour and transfer cost involved if labour has to be moved elsewhere.

On empirical ground, census data for the period 1901 to 1961 show that the proportions engaged in agricultural and non-agricultural sector have been constant over this period. Therefore, it does not appear to be unreasonable to hold this constant for one single production period.

Besides, off farm employment of thirty-five percent is quite high in view of other studies and census data. And it is not unlikely to observe considerable amount of under-employment among this thirty-five percent engaged in non-farming activities. Moreover, there is considerable amount

of unemployment and underemployment in the urban industrial sector itself. And people having special skill for non-farm work are likely to have a first preference for non-farm work than the people on farm. It has been observed by the present writer that in this area, even for government's construction project people are hired from outside because they have special skill for construction work.

For bullock labour only two percent was hired out according to the present sample. This has been taken as fixed and an adjustment has been made in calculating the supply of bullock labour on owned farm after deducting this amount.

Leasing in of land for each of the six crops has been considered as production activity of the respective crops on leased land, for the purpose of consistency. Leasing out of land has been allowed for each of the crops taken separately, as the return from leasing out of land depends on the gross product of the crop for which land is leased out. Borrowing from cooperative societies and borrowing from private sources have been allowed to augment the supply of cash available, at conventional rate of interest. Money lending has been considered in the model, since it is one of the important alternatives which competes for cash expenditure of the farm. Thus, though the model is a partial one, an attempt has been made to include the most important activities, on farm, considered to be relevant for a single production period. Farm Management Study data and experience with farming operation have been the basis for selection of the activities.

---

[1]Rudra, S. Community Development and Surplus Manpower. P. 12. unpublished paper.

Constraints

Linear programming is a good planning technique, provided we have detailed and true information regarding the constraints. This is one of the reasons why linear programming is applied mostly to single farm analysis. In this particular case we are trying to generalise by taking the average of farm within a given size group as a representative farm of that size group. This might provide a guideline to allocation of resources of all farms within that size group provided that variation of constraints of the individual farms from the representative one is of minor nature. Again the ideal approach would have been to classify farms on the basis of all the constraints which is not possible, due to lack of data. However, land is one of the crucial inputs in traditional agriculture and data for the study under consideration show that gross product is highly correlated with acreage under production. In fact very little work has been done so far on the relative importance of different types of constraints and the details of their specification from the point of view of their effect on the final solution. Even when extensive data are collected on cost of production, prices and profits, institutional rigidities and physical constraints are ignored. This is partly due to lack of knowledge and partly due to complications involved in incorporating such factors into the analysis.

When the farmer does not have access to modern inputs, physical constraints like level of land, texture of soil, original qualities of soil suitable for particular crop, time

and amount of rainfall, etc. may become important determinants of resource allocation. Similarly, domestic need for some of the products, facilities for marketing a product, difficulty of hiring some of the factors or production, free availability of other factors may influence decision-making on the farm.

Generally for an average farmer, working under limitations on resources and uncertainties due to vagaries of nature, the resource allocation problem often becomes a matter of adjustment to circumstances rather than looking forward and planning in terms of a long-run perspective.

Institutional factors also play an important role in determining the nature and relative importance of the constraints. For example, presence of a cooperative credit society in the village which lends money at six percent rate of interest makes a difference in the monetary constraint. Because rate of interest for private funds varies from 12 percent to 100 percent, depending on the nature of security provided and sometimes involves conditions such as repayment in terms of crops at a predetermined price. There are other institutional factors such as exchange labour or exchange of human labour for bullock labour, payment in kind which have impact on the constraints.

Classification of the constraints is one of the major problems. One way of looking at them is to separate the inputs under three headings:

1. monetized

2. non-monetized

3. partially monetized.

If this scheme is accepted, then one single constraint, namely cash available for these inputs may be imposed for the monetized part of it. If we assume that there is no barter, the non-monetized item may be accepted as the actual amount of those inputs available. For the partially monetized items, the part that is not monetized can be used as actual amount and for the monetized part the problem can be dealt in a similar fashion as with case one.

A second way of dealing with the problem is to assume that if expenditures on certain items are not monetized, it is simply because of the fact that it does not pay to monetize. Under such assumptions, the imputed value of such items can be included under total cash available and we can allow unlimited amount of trading among inputs provided certain economic conditions are fulfilled. We are going to strike a middle course between these two extremes and try to depict as far as possible the actual situation that prevails.

A total cash constraint is imposed for seed, manure and fertilizers, irrigation charges, rent on leased land, hired human labour, hired bullock labour, and miscellaneous expenses and money lending. This cash constraint can be augmented by borrowing from the cooperative and borrowing from private sources, at stipulated rate of interest. This allows trading among these inputs, provided that the technical conditions of production are satisfied. The cash constraint has been worked out as the amount of monetized inputs minus the amount of borrowed funds, the latter being calculated from the figure given for interest paid in cash.

A part of seeds, manure and irrigation charges are
likely to be owned and a part purchased but in case of these
inputs there are no rigidities involved to make the farmers
use owned inputs, which he finds it hard to dispose of
otherwise. Moreover, supply of these inputs are not on per
time period basis. It is simply that the farmer generally
uses a part of his owned input because it does not pay to
do otherwise.

In each of the cases of human labour we will add
owned labour used on farm and labour unemployed as supply
of owned labour or constraint regarding owned labour. Non-
monetization of this input is due to institutional factors.
There is very little outlet with respect to these two com-
ponents of owned labour. As we have seen before, about 35
percent of total human labour supply is engaged in non-farm
work. Calculation of human labour supply on owned farm has
been shown on Table 14.[1] Percentage of total farm labour
supply to total labour force has been assumed to be fixed at
present level for each of the different size groups of hold-
ings as shown in column 6 of the table. In calculating man
days available from total number of persons, a parity has
been maintained with the number of working days in the
organised industrial sector. Calculation of supply of bullock
labour is shown in Table 15.[2] Bullock days available on farm
have been calculated after deducting two percent hired out and
allowing for the usual number of resting days. Since all the
farms do not have a pair of bullock, the only simplifying
assumption on the basis of which the analysis can stand is

---

[1]Appendix 1 [2]Appendix 1

that there is exchange of bullock labour among farms which is also a common observable phenomenon.

Constraints for leasing in of land have been worked out at 50 percent of owned land in each crop season. This constraint is arbitrary but it takes into account the fact that the supply of land is limited and farm's capacity in terms of fixed capital, implements, etc., are related to the size of the farm.

Borrowing limit from cooperatives has been taken as Rs 100 per acre of owned area subject to a maximum of Rs 500. Borrowing limit from private sources will vary depending on rate of interest and security provided. Since we are allowing for one single rate of interest and since the most common security is land, it has also been taken as Rs 100 per acre of land subject to a maximum of Rs 1000. It is assumed that the same land can be pledged for private credit, even after pledging it for cooperative credit.

Owned capital has not been included in working out the constraint. Because owned capital in the present Farm Management Study is a heterogenous category which includes land, all buildings, wells, implements, etc., it would not have been very meaningful to take the inputed value of all these on an annual basis and put that as a constraint. Each individual item in physical term is important as a constraint. We have already taken into account land, part of the livestock that goes for agricultural production and irrigated acreage under physical constraint. Storage capacity has not been taken into consideration because we do not have data on

either the storage capacity available or the amount of storage space required for each of the activities requiring storaging.

Depreciation of implements have not been included in the model, under constraints, for similar reasons. Implements are of different type and imposing a single constraint in monetary terms will not be very meaningful.

Coefficients

Technical coefficients of production are expressed on per acre basis for the crop production activities. Human labour requirement and bullock labour requirement per acre have been assumed to be different for each size group of holding for the respective activities. The rationale behind this assumption is that there might be labour saving on bigger farms because of economics of scale and division of labour. For the rest of the inputs the coefficients are assumed to be the same for the different size groups of holdings. The coefficients are actual utilization figures averaged over 600 farms[1] for a period of three years. Requirements might differ from actual utilization even under given technique of production. This is due to various reasons. Some of the inputs could not be used for the reason that they were not available in quantity to which they could be used. Again some of the inputs might have been used to the extent where their MVP is equal to zero. Moreover, utilization is tied to the situation prevailing in a given year. Availability of certain inputs, unavailability of others, climatic

---

[1]Two hundred farms for cost accounting data and 400 farms for survey data.

condition, crop failure, prices of certain inputs, might cause variation in the utilization figures. Requirement is rather an abstract concept under the assumption of fixed technical coefficients of production. It implies something more stable than utilization.

However, the utilization figures to be used for the present study relate to 600 farms[1] of different sizes. We are averaging all inputs over a period of three years. For inputs expressed in physical term, there will be variation in the input requirement due to climatic variations. But climatic variation can be taken as part of the normal picture. An alternative way of doing it will be to take out the effect of climate and standardise input requirement but that will represent some ideal input requirement under controlled condition--not the actuality that the farmers are facing every day. When the farmer is putting in most of the inputs such as human labour and bullock labour for ploughing, seeds, part of the manure and fertilizers, at the very initial stage of production, he does not know what the climatic condition is going to be or at what point of the crop cycle climatic condition is going to be unusual. Therefore, if recommendations are made to the farmers for planning purposes regarding the requirements of inputs, it will be fairly reasonable to take average input requirement over the good and bad years.

For inputs that are measured in monetary terms, the problem is more complicated. Because over and above the

---

[1]These 600 farms cover 400 farms included under the survey method, in addition to the 200 included in the cost accounting method.

variation in input utilization in different years due to climatic factors, there will be variation in prices.

However, if it is assumed that variation in input prices are more influenced by demand pull and variation in demand due to variation in climatic condition, is part of the real picture, averaging of prices without deflating, may be justifiable. For any practical purposes, it will be useful to see the trend factor and irregular elements on input prices and follow one procedure or the other depending on the relative influence of each of the above factors on input prices. In the absence of any input price data in the present Farm Management Study the alternatives are either to take a normal year or to take the average of three years, of which the second alternative is chosen because we do not know which year would have been a normal year with respect to all the crops.

Seeds, fertilizers and manures, irrigation charges, hiring of human labour, hiring of bullock labour, repayment of loan, lending of cash--all these are counted in monetary terms. Since input input relationship is fixed, seeds, fertilizers and manures, irrigation charges and miscellaneous expenses have been lumped together as one single input and the coefficient per acre has been calculated in monetary term. Coefficients for all other inputs have been entered as plus or minus one under the respective constraint depending on whether they are draining from the constraint or replenishing it. The prices of all inputs falling under working capital have been entered as coefficients under the cash constraint.

It should be mentioned here that the method of finding the coefficients by production function studies could not be applied for present purposes as data were not available at the individual farm level.

The Objective Function

The objective functions for the crop production activities on owned land and on leased land and for leasing out of land have been expressed on per acre basis. It is calculated as gross income over variable cost for the production of six crops. For crop production activity on leased in land, it has been assumed as computed at 50 percent of gross income from the production of each crop minus variable cost for the respective crop. Because the most predominant arrangement out of many different types of tenancy arrangements prevailing in this area is crop sharing where the leasee generally bears all the cost of production and gets 50 percent of the gross income. Income from leasing out of land has been expressed as 50 percent of gross income for the production of respective crops. This is generally the leasor's share. For leasing in of land computation of the objective function has been on the basis of 50 percent of the gross income from the production of the respective crop for the size group of holding in which the farmer belongs. But for leasing out of land the objective function is taken the same for all the different size groups of holdings which is the average of all farms. This is so because land can be leased out to different types of farms the expected value for decision-making in this respect is likely to be the average. Objective functions for hiring

Tableau Resolved

The optimum solutions that emerge after solving thirty-seven equations with forty-five activities, for each of the eight different size groups of holdings, and the two hypothetical District farms, depict a general picture that conforms to the broad pattern of actual resource allocation, though there are differences in detail. Besides the general pattern of resource utilization emerging from optimum solutions show some tendencies that are pertinent to all the different size groups of holdings, though the nature of activities vary among them. These aspects will be discussed in the subsequent analysis with respect to each of the different resources.

Land:

Land is known as a scarce input in densely populated agriculture, as revealed by its high price and in the high preference attached to the possession of land.[1] In the present optimum analysis amount of owned land is utilized to the fullest extent for all the different size groups of holdings.[2] Secondly, amount of Kharif land leased in is utilized up to the leasing limit for all the different size groups of holding.[3] Thirdly, only a part of the leasing limit for Rabi land remains unutilized.[4] This lends general support to the remark often made

---

[1] India Diffusion Project Study Phase I and Phase II.

[2] Table 21 Appendix 1

[3] Table 21 Appendix 1

[4] Table 21 Appendix 1

-28-

regarding the scarcity of the land resource, with some exception for the bigger size group of holdings in the Rabi season.

Aman paddy is the major crop of the region and almost 71.42 percent of the area is devoted to Aman paddy by the farmers of this area. The optimum solutions show general importance of this crop for almost all size group of holdings as is shown by a range of 35 percent to 100 percent of each size group's land being devoted to Aman Paddy.[1] When percentage of total area devoted to each crop is calculated on the basis of optimum solutions by taking weighted totals, the weights being the number of farms in each size group, it is found that 60.12 percent of owned land available for Kharif season and about 71.35 percent of owned land plus leased land available for the Kharif season is devoted to Aman Paddy. These figures conform closely to the actual percentage of land devoted to Aman Paddy. According to optimum solution the smaller size groups of holdings concentrate on one single crop, i.e., Aman Paddy in the Kharif season, while the larger size groups of holding show a more diversified cropping pattern.[2] There is no supporting data to check to what extent this conforms to the actual picture but this conforms with personal observations in this area, especially in the district of 24 Parganas.

All unirrigated area of owned land in the Rabi season is devoted to pulses [3] which is rather obvious because that is the only crop that can be grown on unirrigated Rabi land.

---

[1]Tables 22, 23, and 25 Appendix 1.

[2]Tables 22 and 25.

[3]Table 22.

However, in actual practice the proportion of unirrigated Rabi land fallow is greater than what it is under optimum solution. This is possibly because of the fact that in actual practice this crop is produced primarily for domestic consumption, and production for the market is not undertaken considering the low return per acre for this crop as shown in Table 12.

No potato is produced for any of the size groups of holding. Instead, all irrigated Rabi land is leased out for potato according to optimum solution. This is because of the fact that gross income from potato is very high and so is cost of production, and as leasing out of land brings in 50 percent of the gross product from that activity, it is more profitable to lease out land for potato than to produce potato on owned land. However, how much land can be leased out for potato will depend upon the demand for leasing in of land for potato. This demand aspect has not been taken into account in the present model. If there is no demand for leasing in of land, potatoes might be produced on owned land depending upon all other factors.

Leasing limit for Kharif land is utilized to the fullest extent by all the different size groups of holdings and the entire leased in land goes to Aman paddy. Only for the size group above 15 acres, the entire leased in area goes to Aus paddy and for the hypothetical farm representing the district Hooghly, a part of the Kharif land is leased in for Mesta. No Rabi land is leased in for the size group of holding 3.76

to 500 acres and 10 to 15 acres. Bullock labour might have been the limiting factor because owned bullock labour is fully utilized for ploughing activity in that season. Cash might have been another constraint and probably it did not pay either to hire bullock labour or to borrow money to lease in Rabi land when profitability of the crop pulses is very low. A part of the Rabi land is leased out for pulses especially for the bigger size groups of holdings while as has been mentioned earlier all irrigated Rabi land is leased out for potato. Leasing out of land does not take place at all in the Kharif season when all land is utilized for crop production purposes. The only exception is the leasing out of land for jute by the size group above 15 acres, and the amount is so small that it can be ignored. Besides bullock labour or cash might have been the constraining factor for cultivating the entire area under own cultivation for the biggest size group of holding. Considerable amount of leasing in of Kharif land takes place according to tableau solution without practically any leasing out activity in the season. This may not be feasible unless we assume that leasing in is possible from outside sources.

Labour

Two other characteristic features of optimum solutions that conform to the real world situation are large amounts of slack human labour and slack bullock labour.[1] This indicates

---

[1]Tables 26, 27 and 28 for human labour.

limited opportunity of employing the available human labour and bullock labour in activities on owned farm and if the proportion of labour unutilized is large for all farms and for all the periods, possibility of hiring out of labour for crop production activity will also be limited.

For the smaller farms up to 3.75 acres, proportion of unutilized human labour on farm is high for all the different time periods, though there is seasonal fluctuation--this indicates some confirmation for the hypothesis[1] that part of the labour engaged in own farming can be removed from the farm without affecting total product. For the smallest size group of holding the amount of removable surplus human labour during the peak labour demand month is as high as 80 percent of owned human labour available on farm. It is about 57 percent for the next size group of holding and about 35 percent for the size group between 2.51-7.50. There is no removable surplus for the size group of holdings having land above 7.50 acres. For the bigger size group of holdings,[2] though the proportion of unutilized labour is high for most of the twelve different time periods, there are one or two peaks when all labour is utilized. No human labour is hired in by any of the different size groups of holdings and this might indicate that marginal value product of labour is less than the wage rate. If we look at the imputed total value of human labour,[3]

_____

[1]Rosenstein Rodan, Disguised overemployment and under-employment in agriculture.

[2]Above 7.50 acres.

[3]Table 25.

which is calculated by multiplying labour utilization figures
of the optimal solution of the different time period by the
wage rate of labour for the respective period, we find that
human labour is the most important input, so far as its share
in total cost is concerned.[1] And this is true for all the
different size groups of holdings.

The major point of difference between the optimum
solution and the actual situation is that some hiring in and
hiring out goes on under the actual situation even within
the agricultural sector and in farming activity itself.
About fourteen percent of the labour is hired out for farm-
ing activity and about seventeen percent of total cost of
production is incurred for hiring labour under actual situation.
The tableau solutions which do not allow any hiring in of
labour might be suggesting that it is not economical to hire
in labour. Another reason might be that there are seasonal
peaks depending on climatic factor, under actual circumstances
necessitating hiring of labour. A certain operation has to
be done within a very short period of time by a particular
farmer depending on level of water on the ground, slope of
land, time of sowing, etc., on his farm, while the particular
operation in general can take place and does take place on
different periods of time within a certain span and the present
model takes into account the latter for a particular operation.
In this case, what is necessary is a finer gadget to measure
labour requirement on each particular farm and a further break-
down of the time interval into shorter time periods. In fact,

---

[1]Table 34

breakdown by twelve different months is a crude way of doing the analysis. Here we are facing a situation where our specifications in conventional manner are inadequate. It can be mentioned in this respect that in certain part, of the State of West Bengal, exchange labour is a very common institution. This is a kind of barter, necessitated by the need of doing an operation on time.

Secondly, some hiring of labour is done as some agricultural operations are not done by the high caste people. However, all these factors are expected to cause marginal changes in the overall picture and the labour surplus in farming activity will still be there if we do not explore the possibility of employing labour off farm or for introducing some technological changes such as irrigation which would increase supply of land in terms of intensity of cropping, or raise marginal value product to bring idle land into production in the Rabi season.

In general the findings with respect to human labour are important and interesting. Given the labour supply that is currently available on farm, the optimum solutions show (1) that marginal value product of labour on farm is zero; (2) there is considerable amount of seasonal unemployment; (3) a part of the surplus labour on farm appears to be removable; and (4) it does not pay to hire labour which in turn implies that wage rate may be higher than marginal value product of labour on farm.

With respect to bullock labour[1] also there is high
underutilization of this input in the optimum solution; but
this is more of a seasonal nature. One peak is observed in
period seven when ploughing is done for Rabi crops and another
peak is observed among all the different size group of holding
having land of more than 3.76 acres, in period 1, when ploughing
starts for Aman paddy and almost all ploughing is done for Aus
paddy, jute and Mesta. In spite of the fact of full utilization
of bullock labour during peaks, bullock labour hiring is done
by only one size group of holding between 10 acres and 15 acres
which devotes 64.63 percent of its total cultivable land in
the Kharif season to jute and bullock labour requirement for
jute is high for that period. Why bullock labour is not
hired by the other size group of holdings is again an empirical
question. A comparison of marginal value product of bullock
labour with payment being made for hiring bullock labour will
be interesting in this respect.

Since unemployment of bullock labour is generally
thought to be of a seasonal nature, recommendations have often
been made in favour of a more diversified cropping pattern for
the fuller utilization of this resource.[2] The present tableau
solutions show that given the constraints under which the farms
are operating, there is very little scope for the fullest
utilization of bullock labour during all seasons if the farmer
is motivated to maximize profit.

---

[1]Tables 29, 30, 31.

[2]Dutta: Economics of Industrialisation.

Cash

All owned cash is utilized under the optimum solution
for all the different size group of holding and in most of
the cases, credit is taken from the cooperatives up to the
borrowing limit[1], which is set as Rs 100 per acre of land.

However, for all the size group of holdings between
0.01 and 10 acres, less than 30 percent of total cash
including borrowed fund is utilized for crop production.
The percentage utilized for crop production is around 50
percent for the two biggest size groups of holdings. The
major part of cash resources goes for money lending according
to the present tableau solution. Borrowing is allowed from
the cooperatives at 6 percent rate of interest while money
lending is allowed to earn 12 percent rate of interest.
Therefore, if no other activity requiring cash is more profit-
able it pays to borrow money at 6 percent rate of interest
and to lend it at 12 percent which is the minimum prevailing
in the indigenous sector. However, only operating capital
has been taken into account in the present model under resource
requirement and all fixed capital and implements have been
left out of the model. This creates an illusive impression
about the availability of cash relative to the need for it
and allows money lending for all the size groups of holding,
irrespective of the returns it can get in various kinds of
capital formation activities, the only conclusion that can
be drawn in this respect is that operating capital utilizes

---

[1]Tables 32, 33, 34.

only part of the fund and money lending may be competing
with other activities requiring cash. Some of these acti-
vities have been included in the model and others have not.

Objective Function

Profit over variable cost increases montonically with
the increase in the size of holdings. The same tendency
remains when net profit is calculated after deducting inputed
values of owned labour imputed values of owned bullock labour,
rent of owned land, depreciation of implements, and interest
on owned capital. Inputed values of owned labour and owned
bullock labour have been calculated by multiplying the amount
of utilization of these resources in different periods by the
respective rates of payment prevailing for these two inputs
in the respective time periods. Rent of owned land, interest
on owned capital and depreciation of implements have been
taken as given constants for the different size groups of
holdings.

However, neither profit over variable cost nor profit
over total cost show any clear tendency to vary in a certain
direction with the farm size from descriptive data, or, in
other words, no scale effect is observed in net profit with
respect to size of holding.

No data are available for profit per acre for the
different size groups of holdings, prevailing under actual
situation and since the cropping pattern of the individual
size group of holdings is also not there one cannot make any
comparison with the actual situation. However, net profit

figures are quite low for most of the size groups of holdings under optimum solution which is also the general case under actual situation.[1] Such comparison too will not be valid in the sense that the optimum solution includes other activities besides crop production. The only conclusion that can be drawn in this section is that the optimum solution does not bring in much in terms of net profit though the situation is different for the different size groups of holdings. The two hypothetical farms which are supposed to represent the two districts show very different crop pattern, Hooghly hypothetical farm specializing in Mesta and 24 Pargana hypothetical farm specializing in Aman paddy. This indicates some of the problems involved in aggregation, when all the farms are pulled together the characteristics might be influenced by one or two extreme values. Hooghly farms might have been influenced by some extreme values and the case needs further investigation.

The linear programming optimizing pattern of resource allocation and resource utilization for eight different size groups of holdings show a general pattern of allocation of resources which is generlaly consistent with the pattern prevailing. It is true with respect to full utilization of land during Kharif season which is the main crop season, with respect to large amount of unutilized human and bullock labour, with respect to overwhelming emphasis given to the production of Aman paddy. A comparison among the smaller and the bigger farms shows concentration on one single crop for the former and a more diversified cropping pattern for the latter. Removability of a part of human labour for

---

[1]Tables 8A, B, C, D, E. Appendix 1.

the former--essentially seasonal nature of labour surplus
on farm for the latter, one peak of bullock labour utilisation
with respect to the former, two peaks of bullock labour uti-
lisation with respect to the latter. In general Aman paddy
is the major crop for all the farms and all farms face the
problem of nonutilisation of available human labour and bullock
labour.

Shortcomings of the Model--Global or Partial Optimum?

The optimum solution obtained is a global one i.e.
for each of the tableau it takes into account all the acti-
vities included in the model with corresponding constraints
and objective functions and by solving them simultaneously
finds the resource allocation that will maximize profit. But
the present model is a limited one, as it takes into account
only part of the activities of the farm family, i.e. the
activities that are related primarily to crop production,
and adjusts the constraints accordingly, i.e., it isolates
the part of the total constraint of a resource that is con-
sidered as relevant for farming activities. However, par-
tialing out a part of the activity makes the model narrow
because all the activities both farm and non farm might be
competing for the same constraint. Therefore, breaking down
the constraints for farm and non farm activities is rather
arbitrary. This had to be done because data were not avail-
able on the non farm activities of the farm family. Background
information has been used as far as possible to isolate the
farming and non farming parts. However, it would have been
more comprehensive to build up a model of the whole inter-
related system having the farm family as the producing unit

with its resources having alternative uses in the different sectors. For example the present model assumes that the part already engaged in non farming activities is a fixed proportion and it has not been determined endogenously through the wage mechanism as to how much should go to the farming and how much should be directed to non farming.

Secondly, the present model takes most of the capital assets to be given. Some of them such as land and livestock have been included in the model as a constraining factor, some others such as storage capacity, implements, etc., have not been included in the model at all, and it has been assumed that they do not act as restraining factors. This has been done as no data are available on the nature of different type of capital goods and the coefficients and constraints associated with each of them. And in the absence of any such data it is not very meaningful to take imputed value of all capital goods as a constraint and work out a coefficient on the basis of interest paid to fixed capital. However, excluding a part of the factors of production from the list of constraint is likely to make the model artificial depending on the relative importance of such constraints. This might not have affected the model seriously, because, from a priori knowledge it can be said that they are not important limiting factors. A more serious weakness arises from excluding aquisition and salvage activity of land and capital from the model. This has been done to avoid complexity in view of limited data available. This simplification might have put emphasis on lending of cash in the present model because other capital aquisition activities are not competing with money

lending for the same amount of available cash and credit.

The fourth limitation arises from excluding the demand side of the picture from the model. An activity cannot assume any value because demand for that activity might be limited. Therefore a comprehensive model should take into account this aspect. This is the reason why the optimum solution is allowing leasing out of land for potato for all the size group holdings while none of the farms in the system is leasing in land for potato. The same problem would have arisen if hiring out of human labour and hiring out of bullock labour were allowed in the model without imposing a restriction from demand side at different wage rates.

Shortcomings of data

The present Farm Management data is pretty exhaustive as regards farming activities. However, there are one or two serious loopholes that have created problems for this analysis. The first serious drawback is that when breakdown is done by the size group of holdings, no data are available for each district taken separately. Secondly, there are no price data available for the crops other than Aman Paddy and Jute. And no data are there for prices of inputs other than wage rate and payment to bullock labour. Thirdly, acreage allocation to different crops is not given when breakdown is done by the size group of holdings. Fourthly, a farm management study is expected to give prices of land and other capital assets used in agriculture. Lastly, more information has been expected about the different type of capital assets and utilization of each in different activities.

New Dimensions: Indications for the extension of the model for further research

The present model uses a limited number of activities due to limitations in certain aspects of data available. In spite of this, however, the model stands the test of work-ability because the general picture emerging from eight different solutions shows a reasonably consistent pattern. The conformity between the actual situation and the optimum solution supports the thesis of efficiency of allocation of resources in traditional agriculture and also demonstrates the usefulness of the model in explaining reality. If the model solution and the real world were different, there could be two basic reasons: (1) the real world situation does not optimise as specified by the model or (2) the model is inadequate to explain reality. It is unlikely that a poor model will conform to the real world by accident. This initial success suggests that it might be worthwhile to develop research along these lines by adding new dimensions to the present model.

One such possibility is to extend the present model beyond crop production activities and to allow for endogenous determination of asset fixity rather than holding some of the assets fixed on the basis of the conventional procedure. Asset fixity can be decided by taking into account the aquisition and salvage prices in relation to marginal value product. An attempt can also be made to incorporate expected prices into the analysis.

Secondly, the price mechanism does not always perfectly reflect the demand for different resources. Therefore, if the restriction from demand side is thought to be important for some of the activities, such as hiring out of labour, leasing out of land, etc., a restriction can be imposed in the form of permissible range for different activities.

Another approach would be to study the impact of changes in relative prices of different crops on resource allocation, profit and production.

Lastly, the present model has some implications as to which inputs act as limiting factors in traditional agriculture. The present model can be extended to study the consequences of different alternative investments in new inputs to reduce existing type of resource shortages. For example a decision can be taken on the basis of model results regarding whether to have an irrigation project or reclamation of marshy low land or leveling of land to increase the supply of land. Further development would present the most profitable investments in a long-term perspective by recursive programming which embodies a sequential chain of recurring linear programming problems, in which the structural components of each year's problem depends on the solution of the previous year.

Outright positivism, i.e., research to describe the universe is of limited value. Widespread acceptance of planning of some sort makes a demand for policy prescription or policy implications in most of the applied economic research. However, when research is oriented towards analyzing the effect

of different alternatives the purpose of the research should

always be kept in view. As a point of clarification it can

be mentioned that the nature of flexibility to be allowed

for the constraints in a linear programming model will depend

upon whether the research is for farm planning for farmers

and extension workers or for the administrators? Another

important factor that can dictate the model is the length of

run to be considered. The particular approach will vary

depending on the nature of the inquiry. All that is necessary

is to raise the specific questions to be answered and then

build up a model tied to the grass roots of the real world.

Conclusions

A careful analysis of the resource situation of a sample of West Bengal farms in the mid-fifties reveals a picture of low return agriculture with extreme scarcity of some resources and considerable amount of surplus of other resources. The case study has been taken as an example of "traditional agriculture" in a densely populated part of the world. An analysis of the resource allocation pattern of such a system is thought to be relevant, even in this era of developing agriculture, because, the 'big push' required to overcome the structural rigidities of traditional agriculture is yet to come in most of the places.

The problems of traditional agriculture excited extensive theoretical discussion and were subject for a number of empirical studies. The present study goes beyond the description of actual resource allocation and attempts to answer the question of conformity between observed allocation of resources and optimum allocation of resources under existing constraints by applying linear programming technique on the basis of a case study. The results of the optimum solutions show general conformity between solution of linear programming model and the actual allocation. Thus additional evidence is presented for efficient allocation of resources on traditional farms.[1]

---

[1]Hopper's Study, "The Economic Organization of a Village in North Central India" claims optimatity in resource allocation. By applying linear production function technique he finds the equality between the marginal value product and marginal factor cost.

More specifically, the present study shows conformity between observed situation and model solution with respect to the acreage allocation of the main crop Aman paddy and with respect to the utilisation of land, human labour and bullock labour.

Land is found to be utilised to the fullest extent, especially in the main crop season, i.e., Kharif, while human labour and bullock labour show considerable amount of slack which indicates the crucial nature of land as the limiting factor. This has an implication for futher research related to the consequences of projects designed to increase the supply of land (such as an irrigation project, which makes it possible to raise two Kharif crops on the same land).

With respect to human labour and bullock labour, the situation is conspicious by the non-utilisation of resources even under optimum solution of the model. This lends support to the hypothesis of zero marginal product of labour, which is true in some of the cases even at harvest time.

There is large time variation in the requirements of both human labour and bullock labour in the model solution. However, no labour is hired even on the large size of farms, that utilise all family labour during peak seasons, thus suggesting that the marginal value product of labour is less than the wage rate. Similar is the case with respect to bullock labour hiring, because the analysis shows only one farm hiring some bullock labour for one of the peaks.

With respect to the removal of resources, the model suggests that a part of human labour from the smaller size of holdings can be removed from the farm without affecting optimum output. Fuller utilisation of human labour and bullock labour may be possible, if rainfed agriculture is transformed into irrigated agriculture, thus allowing for an entirely different type of cropping pattern. No definite conclusion can be drawn with respect to cash resources, since some of the important activities making a demand on cash have not been included in the present model.

A partial equilibrium model, based on crop production activities of the family farms gives a glimpse of reality of traditional agriculture involving the paradox of shortage and surplus--a disparity among the supply of different inputs, causing considerable amount of non-utilisation of resources even under optimum allocation. A realistic estimation of the constraints accounts for the conditions prevailing in the traditional agriculture and indicates the incapability of almost any change toward betterment under given technology and institutional set up, whether the desired change would break through in the agricultural sector or can have its impact on the agricultural sector by influencing the intersectoral flow will be an issue to be examined in the context of growth.

The present research brings out the need for scrutinising the resource constraints, the state of technology, the level of knowledge and the phase of institutional development. And if a judgment is made on the basis of the above, one can expect

to find an adequate explanation of the state of affairs in the traditional agriculture and there will not be any need for building up an isolated model of a peasant's psychological world or for categorising them as a species different from the common run of human beings with respect to motivations and desires. Farmers' attitudes might be a reflection of the real world in which they live but it is hard to predict how far the removal of the so-called psychological barriers can affect a change in the situation by itself. Interdisciplinary communications appear to be inadequate though cross cultural studies are numerous by nature. As a result the farmers live with the complement of "rational profit maximisers" and the condemnation of "fatalist idlers" attributed to them by the scholars concerned with them.

BIBLIOGRAPHY

Basak, K. E., B. K. Choudluri and R. C. Chandra. Studies in the Economics of Farm Management in West Bengal. Combined Report for 1954-55, 1955-56, and 1956-57, of publications. Manager, Government of India, Delhi, 8, 1963.

Clark, Edwards. Resource Fixity, Credit Availability and Agricultural Organisation. Thesis for the degree of Ph.D. Michigan State University, 1958.

Doefman, R., P. A. Samuelson, and R. M. Solow. Liner Programming and Economic Analysis. McGraw-Hill Book Company, Inc., New York, Toronto, and London. 1958.

Dutta, B. Economics of Industrialisation: A Study of the Basic Problems of an Underdeveloped Economy. 3rd Revised Edition, Calcutta, World Press Private, 1960.

Heady, E. G., and W. Candler. Linear Programming Methods. The Iowa State University Press, Ames, Iowa. 1958.

Hildebrand. Farm Organisation and Resource Fixity: Modifications of the Linear Programming Model. Thesis for the degree of Ph.D., Michigan State University, 1959.

Hopper, W. D. The Economic Organisation of a Village in North Central India. Ann Arbor, Michigan, University Microfilm, 1958.

Eicher, C. K. and L. W. Witt. Agriculture in Economic Development. New York, McGraw-Hill, 1964.

Johnson, G. L. and L. S. Hardin. Economics of Forage Evaluation. Purdue Agricultural Experiment Station Bulletin 623.

Khusro, A. M. "Returns to Scale in Indian Agriculture". Indian Journal of Agricultural Economics. July-Dec., 1964. Indian Agricultural Economic Association, Bombay.

Lewis, W. A. Theory of Economic Growth. London, Allen and Unwin, 1955.

Mellor, J. W. and R. D. Stevens. The Average and Marginal Product of Farm Labour in Under-developed Economies. Journal of Farm Economics. Vol. 38. pp. 780-791. Aug. 1956.

Metzger, R. W. Elementary Mathematical Programming. New York. Wiley, 1958.

Nurkse, R.   Underemployment in Backward Economies.   Journal
        of Political Economy, Vol. 66, June, 1958.   The Uni-
        versity of Chicago Press, Chicago.

Pepalasis, A. A. and P. A. Yotopoulos.   Surplus Labour in Greek
        Agriculture, 1953-1960.   Centre of Economic Research,
        Research Monograph Series 2, Athens, Greece, 1962.

Rogers, E. M.   Modernisation Among Peasants--the Impact of
        Communications.   Holt, Rinehart and Winston, Inc.,
        New York, 1969.

Rosenstein, Rodan.   Disguised Unemployment and Underemploy-
        ment in Agriculture.   Monthly Bulletin of Agricultural
        Economics and Statistics, F. A. O., Rome, Vol. 6, No.
        7/8, July-Aug., 1957.

Rudra, S.   Community Development and Surplus Manpower (unpub-
        lished paper).   1966.

Schultz.   Transforming Traditional Agriculture.   New Haven
        and London, Yale University Press, 1964.

Sen, B.   Farm Productivity and Soil Fertility in Indian Farm.
        Indian Journal of Agricultural Economics, 1967, p. 3.
        Indian Agricultural Economic Association, Bombay.

Thorner, Daniel and Alice.   Land and Labour in India.   New
        York.   Asia Publishing House, 1962.

Key to the Variable Name:

Row Name

PROFIT: Objective Function row
KHLAND: Kharif land
RBUL: Rabi unirrigated land
RBIL: Rabi irrigated Land
HLBPi: Human labour for different periods $i = 1 \ldots \ldots 12.$
BLBPi: Bullock labour for different periods $i = 1 \ldots \ldots 12.$
CASH: Cash Available
CRCOOP: Credit from cooperative
CRPRVT: Credit from private sources
LLIKH: Leasing land in limit for Kharif
LLIRB: Leasing land in limit for Rabi

Col. Name

AMAN =   Aman Paddy
AUS =   Aus Paddy
JUTE =   Jute
MESTA =   Mesta
PULSES = Pulses
HLHPi = Hiring in of human labour for period i, $i = 1, 2 \ldots \ldots 12.$
BLHPi = Hiring in of bullock labour for period i, $i = 1, 2 \ldots \ldots 12.$
LLIAMN = Leasing land in Aman
LLIAUS = Leasing land in Aus
LLIJUT = Leasing land in Jute
LLIMES = Leasing land in Mesta
LLIPOT = Leasing land in Potato
LLIPUL = Leasing land in pulses.
LLOAMN = Leasing land out Aman
LLOAUS = Leasing land out Aus
LLOJUT = Leasing land out Jute
LLOMES = Leasing land out Mesta
LLOPOT = Leasing land out potato
LLOPUL .= Leasing land out Pulses
CRCOOP = Borrowing from cooperative
CRPRVT = Borrowing from private sources
LENDING = Lending of cash

TABLE 1.

Percentage Distribution of Acreage

Crops Areas	Aman Paddy	Aus Paddy	Jute	Pulses	Potato	Miscella- neous	Total gross cropped area (Acres)	% of Double cropped area to net area shown
Hooghly	61.69	4.13	15.27	6.81	5.58	16.54	4,155.85	16.54
24 Parganas	75.41	5.05	4.34	6.92	0.52	13.58	10,135.46	13.58
Districts Combined	71.42	4.79	7.52	6.88	1.99	7.40	14,291.31	14.42

Reference: Studies in the Economics of Farm Management in West Bengal - Combined
Report for 1954-55, 1955-56 and 1956-57 by K.C. Basak, B.K. Chondhuli
and R.C. Charda

Computed from: Table A-6 (Dist. Hooghly) p. 186
Table A-6 (Dist. 24 Parganas) p. 187
Table A-6 (Dist. Combined) p. 188

TABLE 2.

Distribution of Irrigated and Unirrigated Area by Size of Farm

Size of Holding	Av. cultivable Area	% of cult. area irrigated	Irr. Area	Unirr. Area
0.01 - 1.25	0.66	18.8	0.13	.53
1.26 - 2.50	1.71	14.3	0.26	1.45
2.51 - 3.75	2.91	12.2	.38	2.53
3.76 - 5.00	4.03	15.5	.67	3.36
5.01 - 7.50	5.61	11.1	.67	4.94
7.51 - 10.00	7.65	6.6	.55	7.10
10.01 - 15.00	11.50	10.2	1.25	10.25
Above 15	17.02	15.7	3.20	13.72
24 Par	2.91	2.0	0.06	2.85
Hooghby	2.37	25.3	.67	1.70
All Farms	2.58	12.6	.36	2.22

Ibid.
Col 1 from Table 2.9 Page 31
Col 2 & 3 from Table 3.8 Page 30
Col 4 calculated from col 1 and col 3.

TABLE 3

Intensity of Cropping According to Size of Farm

Size of Holding	Hooghly	24 Pargan	Districts Combined
0.01 - 1.25	1.16	1.09	1.13
1.26 - 2.50	1.13	1.07	1.09
2.51 - 3.75	1.02	1.07	1.05
3.76 - 5.00	1.05	1.04	1.04
5.01 - 7.50	1.03	1.08	1.06
7.51 - 10.00	0.96	0.97	.97
10.01 - 15.00	1.18	0.98	1.05
Above 15	0.87	0.97	0.91
All Farms	1.06	1.05	1.05

Ibid:

Table 3.10 ,
Page 32

TABLE 4.

Cost of Production under Different Items for Six Crops

	Aman Paddy	Aus Paddy	Jute	Mesta	Pulses	Potato
Human Labor	79.50 (47.33%)	84.07 (50.3%)	119.66 (53.95%)	107.35 (54.22%)	30.11 (40.4%)	258.97 (26.7%)
Bullock Labor	14.69 98.75%)	15.45 (9.2%)	14.40 (6.49%)	12.77 (6.45%)	10.43 (14.0%)	22.24 (2.3%)
Seed	7.86 (4.68%)	9.64 (5.8%)	10.16 (4.58%)	9.95 (5.02%)	8.29 (11.1%)	275.37 (28.4%)
Manure	2.58 (1.54%)	5.92 (3.5%)	8.70 (3.92%)	2.93 (1.48%)	0.03 --	200.11 (20.6%)
Irrigation	--	--	0.01	--	0.01	0.84
Depreciation of Implements	2.36 (1.40%)	1.98 (1.3%)	3.43 (1.55%)	3.96 (2.00%)	1.35 (1.8%)	8.13 (0.8%)
Rent on hand land	25.40 (15.12%)	29.33 (9.7%)	22.00 (9.92%)	27.12 (13.70%)	5.47 (7.3%)	71.69 (7.4%)
Interest	27.47 (16.35%)	14.74 (9.7%)	33.59 (15.15%)	28.55 (14.42%)	5.47 (16.9%)	119.38 (12.3%)
Rent on owned land	5.86 (3.49%)	4.60 (3.0%)	5.67 (2.56%)	3.64 (1.84%)	12.58 (6.1%)	10.33 (1.1%)
Miscellaneous	2.26 (1.34%)	1.42 (1.0%	4.16 (1.88%)	1.71 (0.87%)	4.57 (2.4%)	3.49 (0.4%)
Total	167.98	167.19	221.78	197.98	74.59	

Cal 1: Table 5:5, P 96
Cal 2: Table 5:13, P 103
Cal 3: Table 5:21, P 110
Cal 4: Table 5:29, P 117
Cal 5: Table 5:36, P 122
Cal 6: Table 5:43, P 127

TABLE 5.
Cash Available by Size of Farm

	Total Inputs per acre in rupees	Extent of	Cash exp. Per acre	Av. net sown area
	(1)	(2)	(3)	(4)
0.01 – 1.25	232.57	27.6	64.18	.66
1.26 – 2.50	213.31	26.7	59.95	1.71
2.51 – 3.75	209.77	25.6	53.70	2.91
3.76 – 5.00	183.53	22.6	41.47	4.03
5.01 – 7.50	195.26	22.8	44.52	5.61
7.51 – 10.00	169.02	18.4	31.09	7.65
10.01 – 15.00	147.97	29.6	43.79	11.50
Above 15	156.42	28.9	45.20	17.02
All farms	190.58	24.7	47.07	2.58
Hooghly	228.92	27.8	63.64	2.37
24 – Par	150.84	20.0	30.16	2.91

Ibid
Col 1: Table A-9   P 192
Col 2: Table 6   P 62
Col 3: Computed from Col 1 and Col 2
Col 4: Table 3.9   P 31
Col 5: Computed from Col 3 and Col 4
Col 6: Table A-9   P 192
Col 7: Computed from Col 6   11% rate of interest
Col 8: Computed from Col 7 and Col 4
Col 9: Computed from Col 5 and Col 8

TABLE 5. (continued)

	Total Cash Expenditure	Interest paid in cash for acre	Amount Borrowed Per Acre at 10% rate of interest	Total Borrowed Fund	Cash Available after deducting borrowed fund
0.01 – 1.25	42.35	5.37	53.7	35.44	6.91
1.26 – 2.50	97.38	3.16	31.6	54.63	43.35
2.51 – 3.75	156.27	1.77	17.7	51.50	104.77
3.76 – 5.00	167.12	2.32	23.2	93.49	73.63
5.01 – 7.50	249.75	2.31	23.1	129.59	120.18
7.51 – 10.00	237.83	0.63	6.3	48.19	159.64
10.01 – 15.00	503.58	0.01	0.1	.11	503.58
Above 15	769.30	1.95	19.5	331.69	437.61
All Farms	121.44	2.17	21.7	56.00	65.44
Hooghly	185.19	3.35	33.5	79.40	105.80
24 Parganes	87.86	0.97	9.7	28.23	59.61

TABLE 6

Proportion of Farm, Nonfarm and Unemployed Human Labor

Size of Holding	Farm	Nonfarm	Unemployed
0.01 – 1.25	36.1	34.5	29.4
1.26 – 2.50	33.2	35.2	31.6
2.51 – 3.75	33.2	30.8	36.0
3.76 – 5.00	34.7	35.4	30.0
5.01 – 7.50	32.8	36.8	30.4
7.51 – 10.00	34.2	34.4	31.4
10.01 – 15.00	20.4	48.9	30.1
15.00	34.6	30.7	34.7
All farms	33.7	34.6	31.7

Table 3.19

Page 40

Since there is no data for the districts taken separately, we will use the all farm figure districts combined. Page 40.

TABLE 7

Percentage of Bullock Labor Used for Production

of Crops and Percentage of Unemployed Bullock

	% of Bullock Labor Used for Crop Production			% of Bullock Labor Unemployed		
	Hooghly	24 Pargans	Districts Combined	Hooghly	24 Pargans	Districts Combined
1.01 – 1.25	11.5	4.8	4.7	89.8	88.4	89.1
1.26 – 2.50	7.9	9.3	8.6	87.4	83.1	84.8
2.51 – 3.75	11.6	9.3	10.1	83.3	87.2	86.1
3.76 – 5.00	12.8	14.2	13.3	81.4	82.4	81.9
5.01 – 7.50	14.9	14.2	14.7	82.3	80.6	81.4
7.51 – 10.00	13.7	15.4	14.2	83.8	82.4	83.3
10.01 – 15.00	17.4	10.2	14.5	45.7	88.4	83.1
Above 15	19.9	6.0	16.5	76.3	91.0	80.0
All Farms	12.3	10.5	11.3	82.2	84.8	84.1

TABLE 8A

Profit and Loss per Acre of Aman Paddy on the Basis of Four Concepts of Cost --

Districts Combined

	Cost A1	Cost A2	Cost B	Cost C
0.01 - 1.25	147.28	134.07	90.56	27.04
1.26 - 2.50	157.97	135.71	96.69	40.95
2.51 - 3.75	154.52	127.59	100.39	39.44
3.76 - 5.00	133.33	112.19	80.08	26.80
5.01 - 7.50	172.09	131.96	97.61	48.67
7.51 - 10.00	184.03	141.37	101.19	59.72
10.01 - 15.00	98.67	90.04	59.18	35.25
Above 15.00	122.41	119.47	77.24	45.22
Districts combined all farms	150.91	125.61	90.21	40.93
24 Paraganes	154.24	119.04	80.27	30.28
Hooghly	146.82	129.73	97.35	49.26

Ibid From Table A-22, P 206

TABLE 8B

Profit and Loss per Acre of Aus Paddy on the Basis of Four Concepts of Costs --

	Cost A1	Cost A2	Cost B	Cost C
0.01 - 1.25	157.82	157.26	115.74	12.28
1.26 - 2.50	117.95	103.65	83.40	20.52
2.51 - 3.75	109.03	107.89	79.12	-23.55
3.76 - 5.00	94.12	83.87	67.28	15.82
5.01 - 7.50	108.54	57.30	40.50	-23.08
7.51 - 10.00	149.45	114.71	96.06	22.13
10.01 - 15.00	141.67	141.67	119.79	45.87
Above 15.00	127.85	127.85	120.18	42.96
Districts combined	117.57	87.05	67.51	-0.11
24 Parganes	113.01	64.51	45.50	-22.87
Hooghly	118.40	110.08	90.00	23.23

Ibid From Table 2-32 P 216

TABLE 8C

Profit and Loss per Acre of Jute on the Basis of Four Concepts of Costs

	Cost A1	Cost A2	Cost B	Cost C
0.01 - 1.25	125.67	113.19	118.26	- 42.65
1.26 - 2.50	135.48	122.99	80.84	4.56
2.51 - 3.75	127.31	87.79	61.08	- 16.72
3.76 - 5.00	125.72	105.09	61.78	- 20.73
5.01 - 7.50	141.31	107.76	82.25	9.05
7.51 - 10.00	180.61	159.35	113.51	28.43
10.01 - 15.00	164.75	164.75	110.02	92.43
Above 15.00	65.17	65.17	24.83	-20.12
All Farms District Combined	138.94	116.93	77.67	4.77
Hooghly	129.93	104.68	59.94	- 19.55
24 Parganas	143.85	130.60	105.55	48.62

From Table A-42, Page 226

TABLE 8D

Profit and Loss per Acre of Mesta on the Basis of Four Concepts of Cost

	Cost A1	Cost A2	Cost B	Cost C
0.01 - 1.25	25.01	22.63	-24.44	-81.83
1.26 - 2.50	176.39	161.91	131.81	53.70
2.51 - 3.75	175.19	162.29	128.68	20.12
3.76 - 5.00	141.44	141.15	91.32	36.84
5.01 - 7.50	213.98	148.34	122.51	49.53
7.51 - 10.00	290.71	211.25	194.06	118.60
10.01 - 15.00	98.76	98.76	64.23	53.24
Above 15	261.67	261.67	251.05	107.30
Districts Combined	178.55	15.143	119.24	46.83
Hooghly	238.26	182.23	155.68	78.74
24 Parganas	150.40	136.65	102.22	31.91

Ibid
From Table A-51   Page 235

TABLE 8E

Profit and Loss per Acre of Pulses on the Basis of Four Concepts of Cost

	Cost A-1	Cost A-2	Cost B	Cost C
0.01 -1.25	12.39	10.17	-10.27	-39.22
1.26 - 2.50	34.32	28.56	14.60	-11.92
2.51.-3.75	57.67	54.65	32.19	-13.58
3.76 - 5.00	45.29	42.04	11.57	-11.91
5.01 - 7.50	38.40	26.01	15.94	- 9.73
7.51 - 10.00	46.74	36.76	24.90	- 5.56
10.01 - 15.00	22.56	22.56	3.00	-10.52
Above 15.00	33.04	33.04	27.72	7.98
Districts Combined	41.33	35.91	18.76	- 9.62
Hooghly	32.97	27.17	10.00	- 9.72
24 Pareganas	44.28	39.04	22.06	-10.21

Ibid
From Table A-59, P 243

TABLE 8F

Profit and Loss per Acre of Potato on the Basis of Four Concepts of Cost

	Cost A-1	Cost A-2	Cost B	Cost C
0.01 - 1.25	281.24	226.48	87.40	-83.07
1.26 - 2.50	157.95	123.73	-45.73	-204.07
2.51 - 3.75	36.36	-54.68	-231.37	-420.11
3.76 - 5.00	245.38	163.35	62.64	-128.82
5.01 - 7.50	251.79	228.34	138.22	- 73.14
7.51 - 10.00	595.19	572.48	513.93	365.23
10.01 - 15.00	841.44	841.44	809.30	636.80
Above 15	217.54	217.54	73.19	-54.53
All of farms districts combined	223.69	151.60	21.88	-147.75
Hooghly	223.58	144.40	13.79	-160.12
24 Parganas	469.17	389.03	277.38	199.61

Ibid
From Table A-68   P 252

TABLE 9

Distribution of Sample Farms According to Size

Size of Holding	# of Farms Hooghly	% of Farms Hooghly	# of Farms 24 Parganas	% of Farms 24 Parganas	# of Farms Districts Combined	% of Farms Districts Combined
0.01- 1.25	34	34.0	26	26.0	60	30.0
1.26- 2.50	24	24.0	29	29.0	53	26.5
2.51- 3.75	13	13.0	19	19.0	32	16.0
3.76- 5.00	11	11.0	11	11.0	22	11.0
5.01- 7.50	12	12.0	8	8.0	20	10.0
7.51-10.00	4	4.0	3	3.0	7	3.5
10.00-15.00	1	1.0	3	3.0	4	2.0
Above 15.00	1	1.0	1	1.0	2	1.0

Source: Page 21
          Page 22

TABLE 10

Distribution of Cultivated Area of Sample Farms by Size Group of Holding

Size of Holding	Cultivated Area in Acres Hooghly	% of Total Hooghly	Cultivated Area in Acres 24 Parganas	% of Total 24 Parganas	Cultivated Area Districts Combined	Percent of Total Districts Combined
0.01- 1.25	21.73	7.1	17.33	5.8	39.06	6.5
1.26- 2.50	42.92	14.0	53.15	17.8	96.07	15.9
2.51- 3.75	39.93	13.1	58.10	19.5	98.03	16.2
3.76- 5.00	47.02	15.4	50.18	16.8	97.20	16.1
5.01- 7.50	72.30	23.6	48.21	16.2	120.51	20.0
7.51-10.00	33.01	10.8	28.31	9.5	61.33	10.1
10.01-15.00	16.10	5.3	31.97	10.7	48.07	8.0
Above 15.00	32.73	10.7	11.00	3.7	43.73	7.2

Source: Ibid.
         Page 23

TABLE II

Gross Income Per Acre

Rs. Per Acre

Size of Holding	Aman Paddy (1)	Aus Paddy (2)	Jute (3)	Mesta (4)	Potato (5)	Pulses (6)
0.01- 1.25	204.30	203.28	216.62	101.84	788.19	48.98
1.26- 2.50	217.10	164.20	217.64	235.68	883.42	61.87
2.51- 3.75	219.24	155.00	206.00	221.82	864.43	104.59
3.76- 5.00	182.70	148.86	216.84	245.10	744.61	80.81
5.01- 7.50	234.26	165.40	226.48	277.24	927.91	66.48
7.51-10.00	237.48	187.78	242.03	321.00	909.63	69.35
10.01-15.00	171.64	208.88	263.60	174.52	1080.36	76.98
Above 15.00	196.24	163.78	223.92	375.00	718.45	48.73
24 Parganas	195.89	173.77	208.40	218.86	713.23	82.31
Hooghly	228.15	158.17	226.63	299.10	841.85	59.13
Districts Combined	211.32	167.42	226.52	241.64	822.78	70.44

Source: Col. 1, p. 205, Ibid.
Col. 2, p. 215, Ibid.
Col. 3, p. 225, Ibid.
Col. 4, p. 234, Ibid.
Col. 5, p. 248, Ibid.
Col. 6, p. 242, Ibid.

TABLE 12

Objective Function

Rs. Per Acre

Size of Holding	Aman Paddy	Aus Paddy	Jute	Mesta	Potato	Pulses
0.01- 1.25	191.60	186.30	193.69	87.25	308.38	38.90
1.26- 2.50	204.40	147.22	194.71	211.09	403.61	51.79
2.51- 3.75	206.54	138.02	183.07	207.23	384.62	94.51
3.76- 5.00	170.00	131.88	193.91	230.51	264.80	70.73
5.01- 7.50	221.56	148.42	203.55	262.65	448.10	56.40
7.51-10.00	225.24	170.80	219.10	306.41	429.82	59.45
10.01-15.00	158.94	191.90	240.67	159.53	600.55	66.90
Above 15.00	183.54	146.80	200.99	300.41	238.64	38.65
24 Parganas	183.19	156.79	185.47	204.27	233.42	72.23
Hooghly	215.45	141.19	203.70	284.51	362.04	49.05
Districts Combined	198.62	150.44	203.59	227.05	342.97	60.36

Gross Income -- (cost of seeds + cost of fertilizers and manures + cost of
irrigation charges + cost on miscellaneous account). All
expressed on per acre basis, computed from Table 11 and
Table 20.

TABLE 13

Objective Function for Production Activities on Leased Land

Rs. Per Acre

Size of Holding	Aman	Aus	Jute	Mesta	Potato	Pulses
0.01- 1.25		84.66	85.38	36.33	-85.72	14.41
1.26- 2.50	95.85	65.12	85.89	103.25	-38.10	20.86
2.51- 3.75	96.92	60.52	80.07	96.32	-46.10	42.21
3.76- 5.00	78.65	57.45	85.49	53.51	-107.51	30.32
5.01- 7.50	104.43	65.76	90.31	124.03	-15.85	23.16
7.51-10.00	106.04	76.91	98.10	145.91	-24.99	24.60
10.01-15.00	73.12	57.46	108.87	72.67	60.37	28.41
Above 15.00	85.42	65.91	89.03	162.90	120.59	14.28
All Farms Districts Combined						
Hooghly	101.38	62.10	90.38	134.96	-58.89	19.48
24 Parganas	85.25	69.90	81.82	94.84	-123.15	31.07

Computed as 50 percent of gross product less variable cost for each crop.
Computed from Table 11 and Table 19.

TABLE 14

Labor Supply

Size of Farm	# of Earners Per Acre (1)	Mean Size of Farm (2)	Total # of Earners of the Farm (3)	Percentage of Earners to Total Labor Force (4) man days/month
0.01- 1.25	2.21	.75	1.66	36.1
1.26- 2.50	1.04	1.78	1.85	33.2
2.51- 3.75	0.72	3.14	2.45	33.2
3.76- 5.00	0.59	4.38	2.58	34.7
5.01- 7.50	0.49	6.26	3.07	32.8
7.51-10.00	0.38	8.76	3.33	34.2
10.01-15.00	0.29	12.50	3.63	20.4
Above 15.00	0.21	17.33	3.64	34.6
All Farms	.73	2.89	2.10	31.7
Hooghly	.74	2.37	1.75	--
24 Parganas	.72	2.91	2.09	--

Col. 1: Table 3.18, p. 39, Ibid.
Col. 2: Mean taken from the range of size of holding.
Col. 3: Col. (1) x Col. (2).
Col. 4: Computed from Table 3.16, p. 37, Ibid.
Col. 5: Computed from Col. 13 and Col. 4.
Col. 6: Computed from Table 3.19, p. 40.
Col. 7: From (5) and (6).
Col. 8: 48 hours a week--and 23 man days a month has been followed as the basis of calculation.

TABLE 14 (continued)

Total Labor Force (5)	Percentage of Total Farm Labor Supply to Total Labor Force (6)	Total Farm Labor Supply # of Persons (7)	Labor Supply Per Month in Man Days (8)
4.60	70.6	3.25	74.85
5.57	68.4	3.81	87.63
7.38	64.0	4.72	108.56
7.44	70.1	5.22	120.06
9.36	69.6	6.51	149.73
9.74	68.6	6.68	153.64
17.79	69.3	12.33	283.59
10.52	65.3	6.87	158.01
6.62	68.3	4.52	103.96
5.19	68.3	3.54	81.42
6.20	68.3	4.23	97.29

TABLE 15

Supply of Bullock Labor

Size of Holding	Bullock Per Farm	Bullock Days Available Per Farm (22 Days Per Month)
0.01- 1.25	0.51	11.22
1.26- 2.50	1.21	26.62
2.51- 3.75	1.69	37.18
3.76- 5.00	1.95	34.98
5.01- 7.50	2.31	50.32
7.51-10.00	2.75	60.50
10.01-15.00	3.47	76.34
Above 15.00	5.16	113.52
Districts	1.35	40.50
Combined		
Hooghly	1.26	37.80
24 Palganas	1.45	43.50

Source: Col. 1: Table 3.24, p. 44.
Col. 2: Calculated on the basis of 22 bullock labor days per month.

TABLE 20

Variable Cost Per Acre

	Aman (1)	Aus (2)	Jute (3)	Mesta (4)	Potato (5)	Pulses (6)
Seed	6.81	10.86	8.86	7.71	336.61	7.85
Manure	2.21	8.01	9.38	3.64	222.06	--
Irrigation Charges	--	--	0.01	--	0.44	--
Miscellaneous	4.85	3.37	6.14	1.87	10.40	4.63
Total	13.87	22.24	24.39	13.22	569.51	12.48

Source: Col. 1, page 96.
Col. 2, page 103.
Col. 3, page 110.
Col. 4, page 117.
Col. 5, page 127.
Col. 6, page 122.

TABLE 21

Size of Holding	Total Cultivable Acreage Owned + Leased	Total Cultivable Acreage of Owned Land Slack Kharif	Total Cultivable Acreage of Owned Land Slack Rabi	Total Cultivable Acreage of Owned Land Rabi Irrigated	Total Acreage of Leasing Limit Slack Kharif	Total Acreage of Leasing Limit Slack Rabi	Total Slack Acreage
0.01- 1.25	1.98	0	0	0	0	0	0
1.26- 2.50	5.12	0	0	0	0	0	0
2.51- 3.75	8.72	0	0	0	0	.73	.73
3.76- 5.00	12.08	0	0	0	0	2.01	2.01
5.01- 7.25	16.82	0	0	0	0	0	0
7.26-10.00	22.46	0	0	0	0	0	0
10.00-15.00	34.50	0	0	0	0	5.75	5.75
15+	51.06	0	0	0	0	0	0
Hooghly	6.59	0	0	0	0	.80	.80
24 Parganas	8.72	0	0	0	0	0	0

TABLE 22

Allocation of Acreage Among Different Activities For Own Land (Acres)

Size of Holding	Cultivable Area Own Land			Aman Paddy (2)	Aus Paddy (3)	Jute (4)	Mesta (5)	Potato (6)	Pulses (7)
	Kharif Land	Rabi Unirrigated Land	Rabi Irrigated Land						
0.01- 1.25	.66	.53	.13	.66					
1.26- 2.50	1.71	1.45	.26	1.71					1.27
2.51- 3.75	2.91	2.53	.38	2.91					2.53
3.76- 5.00	4.03	3.36	.67	1.07		2.95			2.92
5.01- 7.50	5.61	4.94	.67	2.15			3.45		.98
7.51-10.00	7.67	7.10	.55	2.63			5.01		1.52
10.00-15.00	11.50	10.25	1.25	.35		11.15			5.89
Above 15.00	17.02	13.72	3.30	12.86	1.14	1.05			
Hooghly	2.37	1.70	.67				2.37		1.70
24 Parganas	2.91	2.85	.06	2.91					2.85

TABLE 23

Allocation of Acreage Among Different Activities for Land Leased In

	Leasing Limit		Leasing Land in Aman Paddy	Leasing Land in Aus Paddy	Leasing Land in Jute	Leasing Land in Mesta	Leasing Land in Potato	Leasing Land in Pulses
	Kharif	Rabi						
0.01- 1.25	.33	.33	.33					.33
1.26- 2.50	.85	.85	.85					.85
2.51- 3.75	1.45	1.45	1.45					.72
3.76- 5.00	2.01	2.01	2.01					
5.01- 7.50	2.80	2.80	2.80					2.80
7.51-10.00	3.82	3.82	3.82					3.82
10.00-15.00	5.75	5.75	5.75					
Above 15.00	8.51	8.51		8.51				8.51
Hooghly	1.18	1.18	.81			.36		.38
24 Parganas	1.45	1.45	1.45					1.45

TABLE 24

Leasing Out of Land For Different Activities

	Leasing Land Out Aman	Leasing Land Out Aus Paddy	Leasing Land Out Jute	Leasing Land Out Mesta	Leasing Land Out Potato	Leasing Land Out Pulses
0.01- 1.25					.13	.53
1.26- 2.50					.26	.17
2.51- 3.25					.38	
3.26- 5.00					.67	.43
5.01- 7.50					.67	3.96
7.51-10.00					.55	5.58
10.00-15.00					1.25	4.35
Above 15.00			1.96		3.30	13.72
Hooghly					.67	
24 Parganas					.06	

TABLE 25

Crop Production Activity of the Farms on Owned Farm and Leased in Areas

Size of Holding	Land Available Owned Area Plus Leasing Limit			Acreage Aman Paddy	Acreage Aus Paddy	Acreage Jute	Acreage Mesta	Acreage Potato	Acreage Pulses
	Kharif Land	Rabi Unirrigated Land	Rabi Irrigated Land						
0.01- 1.25	.99	.86	.13	.99					.33
1.26- 2.50	2.56	2.30	.26	2.56					2.12
2.51- 3.75	4.36	3.98	.38	4.36					3.25
3.76- 5.00	6.04	5.37	.67	3.08		2.95			2.92
5.01- 7.50	8.41	7.74	.67	4.95			3.45		3.78
7.51-10.00	11.49	10.42	.55	6.45			5.01		5.24
10.00-15.00	17.25	16.00	1.25	6.10		11.15			5.89
Above 15.00	25.53	22.23	3.30	12.86	9.65	1.05			8.51
Hooghly	3.55	2.37	.67				2.73		2.08
24 Parganas	4.36	4.30	.06	4.36					4.30

TABLE 25 (continued)

	% of Kharif Land For Aman	% of Kharif Land For Aus Paddy	% of Kharif Land For Jute	% of Kharif Land For Mesta	% of Unirrigated Rabi Land For Pulses
0.01- 1.25	100				38.00
1.26- 2.50	100				82.81
2.51- 3.75	100				74.54
3.76- 5.00	50.99		49.01		48.34
5.01- 7.50	58.85			41.02	44.95
7.51-10.00	56.13			43.60	50.28
10.00-15.00	35.36		64.63		36.81
Above 15.00	50.29	37.80	4.11	76.90	38.28
Hooghly	0				58.59
24 Parganas	100				100

TABLE 26

Human Labor Days Unutilized in Farm Activities (Total Farm Human Days—Total Man Days Utilized on Own Farm)

	HLB P1	HLB P2	HLB P3	HLB P4	HLB P5	HLB P6	HLB P7	HLB P8	HLB P9	HLB P10	HLB P11	HLB P12	HLB Available in Each Period
0.01- 1.25	73.96	73.96	67.68	63.97	68.39	73.03	72.77	69.68	60.15	70.65	70.53	74.46	74.85
1.26- 2.50	85.32	85.32	69.15	59.60	70.96	82.95	77.31	73.20	49.74	74.30	70.62	85.65	87.63
2.51- 3.75	104.46	104.46	75.90	58.99	79.08	100.23	77.71	79.73	41.54	78.60	44.28	102.74	108.56
3.76- 5.00	90.15	112.18	18.80	51.57	10.39	104.41	104.57	102.88	77.91	103.19	87.85	111.11	120.06
5.01- 7.50	118.61	139.91	35.51	60.96	28.51	130.69	127.14	122.04	80.31	123.40	102.85	139.52	149.73
7.51-10.00	113.73	142.12	10.13	45.77	.56	130.19	121.36	120.14	72.83	120.45	84.39	139.88	153.64
10.00-15.00	203.78	264.90	25.87	128.39	0	246.04	253.55	254.10	213.73	253.45	221.15	261.20	283.59
Above 15.00	102.62	135.62	25.38	24.02	0	121.35	120.72	98.80	0	105.25	80.47	135.06	158.00
Hooghly	57.87	77.77	8.09	41.08	0	71.17	70.90	74.86	68.93	73.43	59.54	74.44	81.42
24 Parganas	93.80	96.41	69.47	55.08	72.20	90.22	70.98	72.66	40.21	71.62	41.82	92.26	97.29

TABLE 27

Own Human Labor Utilized Per Period

Size of Holding	HLB P₁	HLB P₂	HLB P₃	HLB P₄	HLB P₅	HLB P₆	HLB P₇	HLB P₈	HLB P₉	HLB P₁₀	HLB P₁₁	HLB P₁₂	Imputed Value of H.L.B. (in Rs.)
0.01- 1.25	.89	.89	7.17	10.88	6.46	1.82	2.08	5.17	14.70	4.20	4.32	.39	126.97
1.26- 2.50	2.31	2.31	18.48	28.03	16.67	4.68	10.32	14.43	37.89	13.43	17.01	1.98	359.03
2.51- 3.75	4.10	4.10	32.66	49.57	29.48	8.33	30.85	28.83	67.02	29.96	64.28	3.82	756.18
3.76- 5.00	38.86	29.91	7.88	101.26	68.49	109.67	15.65	15.49	42.15	16.87	32.21	8.95	1048.56
5.01- 7.50	31.12	9.82	114.22	88.77	121.22	19.04	22.59	27.69	69.42	26.33	46.88	10.21	1266.16
7.51-10.00	39.91	11.52	143.51	107.87	120.66	23.45	32.28	33.50	80.81	33.19	69.25	13.76	1527.47
10.01-15.00	79.81	18.69	18.69	257.72	155.20	283.59	37.55	30.04	29.49	69.86	30.14	22.39	2227.97
Above 15.00	55.38	22.38	132.62	133.98	158.00	36.65	37.28	59.20	158.00	52.75	77.53	22.94	2032.63
Hooghly	23.55	3.65	73.33	40.34	81.42	10.25	10.52	6.56	12.49	7.99	21.88	6.98	727.26
24 Parganas	3.49	.88	27.82	42.21	25.09	7.07	26.31	26.63	57.08	25.67	55.47	5.03	644.41
Wage Rate of Human Labor	2.09	2.12	2.20	2.22	2.19	2.16	2.14	1.92	2.19	2.10	2.05	2.00	

TABLE 28

Percentage of Human Labor Unutilized Per Period

	HLB P_1	HLB P_2	HLB P_3	HLB P_4	HLB P_5	HLB P_6	HLB P_7	HLB P_8	HLB P_9	HLB P_{10}	HLB P_{11}	HLB P_{12}
0.01- 1.25	98.81	98.81	90.42	85.46	91.36	97.57	97.22	93.09	80.36	94.38	94.22	99.48
1.26- 2.50	97.36	97.36	78.91	68.01	94.66	88.22	88.22	83.53	56.76	84.79	80.54	97.74
2.51- 3.75	96.99	96.99	54.33	72.84	92.32	71.58	71.58	71.20	38.26	72.40	40.78	94.65
3.76- 5.00	75.08	93.43	15.15	42.95	86.54	91.34	87.09	85.69	64.89	85.94	73.17	92.54
5.01- 7.50	79.22	93.44	23.71	40.71	19.04	87.28	84.91	81.51	53.63	82.41	68.69	93.18
7.51-10.00	74.02	92.50	6.59	29.79	.36	84.73	78.98	78.19	47.40	78.39	54.92	91.04
10.00-15.00	71.83	93.41	9.12	45.27	0	45.27	86.75	89.60	75.36	89.73	77.98	92.10
Above 15.00	64.94	85.83	16.06	15.20	0	76.80	76.40	62.53	0	66.61	50.93	85.48
Hooghly	71.07	95.51	9.93	50.45	0	87.41	86.57	91.94	84.65	90.18	73.12	91.42
24 Parganas	96.41	99.09	7.14	56.61	74.21	92.73	74.68	74.68	41.33	72.58		

TABLE 29

Bullock Labor Days Unutilized in Farm Activities

(Total Farm Bullock Days—Total Bullock Days Utilized on Own Farm)

	BLB P_1	BLB P_2	BLB P_3	BLB P_4	BLB P_5	BLB P_6	BLB P_7	BLB P_8	BLB P_9	BLB P_{10}	BLB P_{11}	BLB P_{12}	BLB Available in Each Time Period
0.01- 1.25	10.03	10.03	1.69	1.69	11.22	11.22	6.26	11.22	8.84	11.22	11.22	10.66	11.22
1.26- 2.50	24.11	24.11	6.44	6.44	26.62	26.62	0	26.62	21.50	26.62	26.62	23.66	26.62
2.51- 3.75	32.82	32.82	2.08	2.08	37.18	37.18	0	37.18	28.46	37.18	37.18	32.53	37.18
3.76- 5.00	0	26.79	12.35	12.35	34.98	32.17	0	34.94	29.31	34.98	34.98	20.38	34.98
5.01- 7.50	0	38.35	9.74	9.74	50.32	46.86	0	50.32	40.16	50.32	50.32	30.91	50.32
7.51-10.00	0	46.39	15.31	15.32	60.50	56.29	0	60.50	47.33	60.50	60.50	36.92	60.50
10.01-15.00	0	52.63	33.91	33.91	76.34	67.19	0	76.34	65.61	76.34	76.34	31.05	76.34
Above 15.00	0	86.10	29.96	29.96	98.07	112.74	28.50	113.52	92.54	113.52	113.52	74.08	113.52
Hooghly	4.94	32.05	31.12	31.12	37.80	35.34	0	37.80	36.13	37.80	37.80	23.75	37.80
24 Parganas	39.79	39.79	13.85	13.85	43.50	43.50	2.86	43.50	36.09	43.50	43.50	38.98	43.50

TABLE 30

Own Bullock Labor Utilized Per Period

Size of Holding	BLB P1	BLB P2	BLB P3	BLB P4	BLB P5	BLB P6	BLB P7	BLB P8	BLB P9	BLB P10	BLB P11	BLB P12	Imputed Value of BLB in Rs.
0.01- 1.25	1.19	1.19	9.53	9.53	0	0	4.96	0	2.38	0	0	.56	49.16
1.26- 2.50	2.51	2.51	20.18	20.18	0	0	26.62	0	5.12	0	0	2.96	133.46
2.51- 3.75	4.36	4.36	35.10	35.10	0	0	37.18	0	8.72	0	0	4.65	216.00
3.76- 5.00	34.98	8.19	22.63	22.63	0	2.81	34.98	.04	5.67	0	0	14.60	197.86
5.01- 7.50	50.32	11.97	40.58	40.58	0	3.46	50.32	0	10.16	0	0	19.41	367.55
7.51-10.00	60.50	14.11	45.19	45.19	0	4.21	60.50	0	13.17	0	0	36.75	451.05
10.01-15.00	76.34	23.71	42.43	42.43	0	9.15	76.34	0	10.73	0	0	45.29	523.49
Above 15.00	113.52	27.42	83.56	83.56	15.45	.78	85.02	0	.78	0	0	39.44	726.54
Hooghly	32.86	5.75	6.68	6.68	0	2.46	37.80	0	1.67	0	0	14.05	171.66
24 Parganas	3.71	3.71	29.65	29.65	0	0	40.64	0	7.41	0	0	4.52	198.74
Wage Rate of Bullock Labor	1.50	1.60	1.70	1.70	1.70	1.60	1.65	1.50	1.70	1.50	1.50	1.50	

TABLE 31

Percentage of Bullock Labor Days Unutilized in Farming Activities

	BLB P1	BLB P2	BLB P3	BLB P4	BLB P5	BLB P6	BLB P7	BLB P8	BLB P9	BLB P10	BLB P11	BLB P12
0.01- 1.25	89.39	89.39	15.06	15.06	100.00	100.00	55.79	100.00	78.78	100.00	100.00	95.00
1.26- 2.50	90.57	90.57	24.19	24.19	100.00	100.00	0	100.00	80.77	100.00	100.00	88.88
2.51- 3.75	88.27	88.27	5.59	5.59	100.00	100.00	0	100.00	76.55	100.00	100.00	87.49
3.76- 5.00	0	76.58	35.31	35.31	100.00	91.96	0	100.00	83.79	100.00	100.00	58.26
5.01- 7.50	0	76.21	19.35	19.35	100.00	93.12	0	100.00	79.81	100.00	100.00	61.42
7.51-10.00	0	76.67	25.30	25.30	100.00	93.04	0	100.00	78.23	100.00	100.00	54.41
10.01-15.00	0	70.79	44.41	44.41	100.00	88.01	0	100.00	85.94	100.00	100.00	40.67
Above 15.00	0	75.84	26.39	26.39	86.39	99.31	25.10	100.00	81.51	100.00	100.00	65.25
Hooghly	13.06	84.78	82.33	82.33	100.00	93.49	0	100.00	95.58	100.00	100.00	62.83
24 Parganas	91.47	91.47	31.83	31.83	100.00	100.00	6.57	100.00	82.96	100.00	100.00	89.61

TABLE 32

Utilization of Cash, Credit Cooperative and Credit Private

Size of Holding	Own Cash	Credit Cooperative	Credit Private	Total Cash	Lending	Slack Own Cash	Cash Entering Into Activities Other Than Lending	% of Total Cash Entering Into Activities Other Than Lending	% of Total Cash Lent Out
0.01- 1.25	6.91	66.00	0	72.91	57.01	0	15.90	21.80	78.20
1.26- 2.50	43.35	171.00	0	214.35	160.38	0	53.55	24.98	75.02
2.51- 3.75	104.77	291.00	0	395.77	307.63	0	88.14	22.27	77.73
3.76- 5.00	73.68	403.00	0	476.68	340.26	0	136.42	28.62	71.38
5.01- 7.50	196.35	500.00	0	696.35	544.93	0	151.42	21.74	78.26
7.51-10.00	267.75	500.00	0	767.75	558.82	0	208.93	27.21	72.79
10.01-15.00	503.58	500.00	0	1003.58	539.77	0	463.81	46.21	53.79
Above 15.00	437.61	500.00	0	987.61	500.00	0	487.61	49.37	50.63
Hooghly	105.80	237.00	0	332.80	271.00	0	61.80	18.56	81.44
24 Parganas	59.61	291.00	0	350.61	251.89	0	98.72	28.15	71.85

TABLE 33

Rent of Owned Land, Depreciation of Implements and Interest on Owned Capital

Size of Holding	Av. Size of Cultivable Area in Physical Unit	Rent of Owned Land Per Acre (Rs.)	Depreciation of Implements in Rupees Per Acre	Interest on Owned Capital in Rs. Per Acre	Total Rent of Owned Land in Rs.	Total Depreciation of Implements (Rs.)	Total Interest on Owned Capital in Rs.
0.01- 1.25	.66	7.62	3.04	44.42	5.01	2.01	29.31
1.26- 2.50	1.71	6.28	2.76	37.68	10.73	4.72	64.43
2.51- 3.75	2.91	5.47	3.00	27.41	15.92	8.73	79.76
3.76- 5.00	4.03	5.60	2.11	30.38	22.57	8.50	122.43
5.01- 7.50	5.61	5.37	2.03	20.70	30.13	11.38	116.12
7.51-10.00	7.67	5.07	1.67	31.95	38.89	12.80	245.05
10.00-15.00	11.50	4.96	2.87	28.73	57.04	33.00	330.40
Above 15.00	17.02	5.21	2.58	33.28	88.67	43.91	566.42
Hooghly	2.37	6.47	2.49	33.62	15.33	5.90	79.68
24 Parganas	2.91	5.04	1.87	25.54	14.66	5.44	74.32

TABLE 34

Profit Over Variable Cost and Profit Over Fixed Cost

Size of Holding	Profit Over Variable Cost	Imputed Value of Owned H. Labor	Imputed Value of Owned B. Labor	Rent of Owned Land	Depreciation of Implements	Imputed Value of Owned Capital	Profit (TR-TVC -TFC)	Profit Over Variable Cost Per Acre	Profit Over Total Cost Per Acre
0.01- 1.25	226.77	126.97	49.16	5.01	2.01	29.31	14.31	343.59	21.70
1.26- 2.50	626.31	359.03	133.46	10.73	4.72	64.43	53.94	366.20	21.70
1.26- 2.50	626.31	359.03	133.46	10.73	4.72	64.43	53.94	366.20	21.70
2.51- 3.75	1203.49	756.18	216.00	15.92	8.73	79.76	383.90	413.57	131.92
3.76- 5.00	1365.55	1048.56	197.86	22.57	8.50	122.43	-34.37	338.11	-8.53
5.01- 7.50	2200.79	1266.16	367.55	30.13	11.38	116.12	409.45	392.29	72.98
7.51-10.00	2999.07	1527.47	451.05	38.89	12.80	245.05	523.81	11.01	68.29
10.01-15.00	4223.31	2227.97	523.49	57.04	33.00	330.40	1051.41	367.24	91.42
Above 15.00	5515.90	2032.63	726.54	88.67	43.91	566.42	2058.73	324.08	120.96
Hooghly	1156.83	727.26	171.66	15.33	5.90	79.68	157.00	488.11	46.58
24 Parganas	902.66	644.41	198.74	14.66	5.44	74.32	-34.51	310.19	-11.86