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# NOTES

## PROBLEMS IN USING FARM ACCOUNTS FOR DECISION MAKING

Farm accounts have been used for many purposes during the past half century—for determination of efficiency of operations, price fixing, tax reporting, etc. In the U.S.A., a renewed interest was brought about with the use of electronic data processing which processes the accounts quickly and gives a report. In India and other countries, interest continues because of the need for information about farm operations. Often accounts are glamourized without a clear conception of how accounts fit into the requirements for making decisions. Decisions take innumerable forms each with its own data requirements and an accounting system to fit each is difficult to conceive. The particular recommendation or decision depends upon the measurement standards and procedures used, and accounts which are historical facts are unorganized for such purposes.

### *Purpose*

It is the contention of this paper that farm accounts are generally used for various recommendations and decisions without due regard for the inherent weaknesses. Thus, the purpose is to point out some weaknesses and explain why they are important. Farm accounts are extremely useful and necessary for special purposes, especially for codifying for tax administration which requires uniformity. However, the carrying of these exacting requirements into decision making can be misleading and even treacherous. Everyone would like a clear-cut well-defined set of criteria which would indicate the degree of "goodness" of the decisions made. and it is contended here that economic concepts with rough metrical approximations will lead to better decisions than the usual accounting procedures with inaccurate or poor economic content. When used together more can be gained by using economic concepts as arbiters of accounting fashions.

### *Types of Accounts*

Many types of accounts are utilized by farmers and each will serve a particular purpose. A labour account may be desirable to record the hired and/or family labour used. Or, a cash account can be used which merely indicates the sales or cash income and the cash expenses. Perhaps the farmer only wants to know if his cash income exceeded his cash expenses. These accounts serve specific purposes and to the extent they provide the user what he wants to know then perhaps they are useful.

The type of account which is considered here refers to the more complete general purpose account the summary of which presumably indicates how well the farmer did financially and suggests possible resource adjustments.

### *Measuring Profits*

Profit plays a central role in decision making and because of this, profit must not have multiple meanings. The inability of accounting profits to measure the economic concept of profits can distort many decisions, particularly when the conceptual conflicts between accounting conventions and economic analysis are not understood.

There exists no satisfactory accounting measure of farmer's success. The annual maximum profit goal as usually determined by accounts does not truly reflect the monetary goal and it may be considered at best an arbitrarism. If values are measured in monetary terms and the objective is to maximize cash at the end of an accounting period, then a simple meaning can be given to the "best" thing to do. However, this is not a logical goal. Instead, some more logical measures are used and maximized, such as net return to labour or investment during some defined period of time which is meaningful in terms of personal objectives, family requirements, and the expected productive life span of the farmer himself.

In the under-developed countries particularly, profit in the sense of cash revenue after deduction of all cash as well as imputed expenses has little practical significance. Where cultivation is based on family labour which has practically no opportunity costs, the farm family would tend to push the labour input to the point of zero marginal productivity. Many other farm inputs such as bullock labour and irrigation labour, are likely to be used in large quantities yielding low marginal productivity. But, when a market wage rate is imputed to family labour and all other expenses including the imputed expenses are deducted, the farm may appear to be incurring a loss. The decision to maximize profit by restricting the labour input, and hence output, to the point where marginal productivity of labour is equal to the prevailing wage rate would indeed be misleading.

Cost accounting assumes that each activity on a farm can be costed independently of all other activities, that profit is a gross return minus the costs, and that farmers desire to maximize this difference. Since inputs and products usually have some degree of complementarity, it is very difficult to determine a meaningful cost of production figure. The importance of the quantity and quality of the asset structure on profits raises the question of what is an asset and of assigning a monetary value, particularly when it can be defined in a variety of ways. If it is defined in non-monetary terms, such as any aspect of a farmer's environment which provides a choice for a group of activities the problem becomes particularly great. An increase in the number and quality of choices available at a given time can be regarded as an increase in assets. The type of asset—a multiple purposed or specialized—contributes also to the vagueness of the accounting concept of profit. Further, the unpredictability of technological change makes the return on undepreciated book value of assets a misleading measure in determining performance.

Ratios, such as rate of return on investment, labour return, return per acre, return per unit of feed, etc., have been used to supplement the profit measure as an indication of the level of managerial performance and the advisability of making future adjustments. In an under-developed economy, technical efficiency as measured by the magnitude of the physical input-output ratio seems to be of little value when the significance of opportunity cost of the factors is considered.

The fundamental question of what to do in the future cannot be answered by these measures either in developed or under-developed economies since they are backward rather than forward looking in nature. The return, if that can be ascertained, is a function of many decisions made subsequently to the initial decision. One can never konw what the outcome will be from a decision if he must make many more subsequently affecting that return.

*The Time Period*

The question of the time period arises when any measure of return is adopted, whether it be a crude measure of profit or return to some input. Accepting some measure of return as a criterion the decision whether or not a farmer should choose a particular alternative is to a large extent a function of time. With an uncertain future, the appropriate time span has no clear answer. Also, the degree of flexibility desired and its cost is largely a function of time and the conventional accounting system provides no systematic way of analyzing the problem of the cost involved to obtain a given flexibility. Farmers often choose a more flexible but less profitable alternative in order to cope with risks and uncertainties.

Decisions for one-year intervals, where forecasts are fairly definite and uncertainties are not so great as to obscure the long-run planning objectives, may result in lower returns than if a distant planning horizon were used where flexibility can be incorporated to meet uncertainties. Accounts will not indicate whether the maximum profits for a year would be maximum over a 10 to 15-year period. The planning horizon is in a large part what a farmer wants it to be, *i.e.*, he has the ability to extend it through improvement of his own knowledge. Since product complementarity requires time to be realized, the length of the planning horizon as related to production periods becomes rather fundamental in the profit determination for the accounting year.

*The Residual Problem*

The use of a residual as the return to a factor, such as management or labour and management, land, etc., assumes that all other factors have been "rewarded" according to their marginal value productivity. What is left and assigned as the factor return is assumed to be equal to the marginal value productivity of that factor. This is hardly true in the real world as the market prices—input and product prices—may be considerably different from what marginal productivity estimates may indicate. However, if the function is a linear homogeneous production function with constant returns to scale throughout, then one can accept the residual method as an appropriate procedure.

*Alternative Decisions*

Farm accounts provide very little help to increase the managerial skill of farmers. They do not reveal the returns which would have resulted had alternative decisions been made. Even though a return may indicate a decided improvement over the past year, there is no indication in the account itself that a greater increase in returns might have been made. However, farm accounts can provide a memorandum of the activities performed and when this information is integrated with the judgment and imagination of the farmer, he might be able to conclude that the results of another decision would have been different. A farmer pleased with his return relative to an average or some norm may shun some worthwhile adjustments in resource use.

Accounts supposedly provide farmers a scale in terms by which past performances can be evaluated. It is questionable whether accounts provide such a scale. Whether a return is lower than it should be is difficult to ascertain because accounts do not provide any analysis of alternatives in terms of opportunitie foregone. For example, if a farmer fails to acquire an asset, or if he holds an asset idle, there is no direct cost recorded in the financial record. The wastage arising out of keeping family labour idle because of caste or social reasons is not reflected in the cost.

The attempt to consider the inventory of supplies or the quantity of capital involved is a recognition that costs so incurred are important and since these are a function of time, an arbitrary split of the time dimension can lead to rather crude decisions. Therefore, the profit item in the financial statement may not be necessarily a measure to maximize. A large profit item in a particular year does not necessarily imply that a farmer has done a good job, *e.g.*, the market situation or a very favourable weather conditions may have been the principal factors and a better job may have increased his profit several times.

*Allocation of Overhead*

Accounts often penalise many decisions by making them share in overhead or other charges not in proportion to the value of the decision. From a managerial standpoint, problems of allocation of overhead are rather complicated and when a farmer determines the cost of a product, he gets a historical, fully allocated, average unit cost. There appears to be very few decisions for which this kind of cost is relevant. Full unit costs obtained from conventional accounts give the sense of authoritative preciseness that is not present and may lead to serious errors if used in making decisions for which they are not appropriate.[1] In many situations, a better decision can be made if allocations are confined to the overhead that vary with the decision. This would eliminate the traditional equity basis, *i.e.*, each product should bear its "fair" share of the overhead.

Moreover, economists have many misgivings about straight-line, original cost depreciation, and perhaps for most decisions, the opportunity cost concept has more meaning. Depreciation charge based not on the original investment but on the earning power of the investment on the farm may prove far more appropriate in most cases. Replacement cost depreciation is preferable in most cases to original cost but in some cases it does not go far enough.

Accounting practice treats all non-traceable costs alike in that no distinction is made between competitive and joint products, *i.e.*, those products with variable proportions depending upon the choice indicator and those that must be produced in fixed proportions regardless of the choice indicator. The costs are generally allocated on some traditional and arbitrary basis, such as sales value without regard to a more logical basis, variable and fixed overhead or a variable and fixed product mix. When overhead costs are large in relation to the value of product output, economic errors due to accounting allocations can indeed be large.

1. See Neelkantha Rath, "On Fixation of Prices in Agriculture on Basis of Cost of Production," *Artha Vijñāna*, Vol. 7, No. 4, December, 1965, for a vivid discussion on limitations of using cost data for fixing prices of agricultural commodities. It was shown that different cost concepts will give different prices and the choice among these will be largely arbitrary. Also, costs per unit of produce vary from farm to farm and the choice of any particular cost would be not only arbitrary but lead to a very significant change in the relative price structure of the same crop over regions, as well as among various crops. He concluded that cost of production data by themselves cannot provide any basis for fixation of prices of farm products.

*Summary and Conclusions*

From the above, it may be concluded that the usual farm accounting procedures have several severe limitations for decision making purposes. (1) Farm accounting provides no satisfactory scale of values or goals of the farm business. (2) The accounting period of one year and decisions thus made based on past performances, are not in harmony with long-run planning objectives, resulting probably in lower returns. (3) The residual method does not provide a true measurement of managerial efficiency or return to a factor. (4) Overhead costs that are not variable with the decision, thus, not pertinent (*i.e.*, costs) to the problem are allocated to the individual products on an illogical basis. (5) No distinction is made as to the degree of jointness of the product. (6) No recognition is given to the significance of the controllability of the product mix in determining the incremental and opportunity costs relevant to specific decisions.

A careful analysis of the economic characteristics of the managerial problems and the production processes involved must be used in enhancing the possible contribution of farm accounts to decision making. Otherwise, they will serve primarily as records for tax reporting. Perhaps, accounts can be useful in the beginning but they must be drastically adopted utilizing a mixture of economic and statistical analysis, judgment and imagination. Also, much attention must be given to the role that subjective values play in the management of farms. Increased attention is also needed on the ways and means by which farm accounts can be used to increase the skill with which managerial tasks are performed. Farm accounts should be designed not only to meet the needs for tax reporting purposes but oriented toward solving the managerial problems rather than toward a historical description of the transactions which transpired during a year and analysed in an arbitrary fashion.

JOHN C. REDMAN*

## IMPACT OF CROPPING PATTERN ON AGRICULTURAL OUTPUT: A MEASUREMENT†

At present there is no known technique by which the effect of changes in cropping pattern on agricultural output can be measured. Some attempts, however, have been made in this respect. For instance, in a study entitled "Changes in Cropping Pattern : Study of U.P.,"[1] S. S. Bhatia tries to indicate the changes due to cropping pattern between two periods of time in the following way.

In the first instance, the area under each of the crops in the first and second points of time is expressed as a percentage of the total cropped area in the corresponding period. Then the percentage at the first point of time is deducted from that at the second point in order to arrive at the changes in a particular crop due to

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1. *The Economic Weekly*, Vol. XVII, No. 34, 21 August, 1965.

cropping pattern. In order to arrive at the total change in the cropping pattern, Bhatia then sums up the differences in the percentage of all the individual crops, which in all cases will add upto zero if the list of crops is exhaustive, unlike that presented in his table which covers only about 97 per cent of the area.

Therefore, the method suggested by Bhatia at best tells only how a particular crop has changed in importance in the overall cropping pattern and fails to give a measure of the total changes in the cropping pattern.

Another attempt in this direction is that of C. H. Hanumantha Rao.[2] Rao is interested in the contribution of cropping pattern changes in the total changes in agricultural output. He explains the changes in output due to cropping pattern in the following terms :

"The growth rate of output that is ascribable to changes in crop pattern is given by the difference between the actual *growth rate* of output and the *growth rate* that would have obtained if the crop pattern remained the same, *i.e.*, when the ratios of individual crop acreages to total cropped are held constant at the level prevailing in 1952-53." (Italics mine.) Obviously, Rao's contention is not correct because the rates of changes in the various factors are not additive.

An alternative method which takes care of the drawbacks in the earlier mentioned ones is discussed in this paper. For convenience of discussion and understanding, we assume here that the changes in output can be explained fully by the changes in area, price and the yield rate of individual crops. The changes in the areas under individual crops consist of two parts, namely, (i) the one that would have taken place if there was only a change in the total sown area with no change in cropping pattern and (ii) the other that due to cropping pattern.

On the basis of the assumption given above, the change in the total output can be expressed by the following formula :

$$Z_V = \sum_i (a_{li}\ y_{li}\ p_{li}) - \sum_i (a_{oi}\ y_{oi}\ p_{oi})$$

where $Z_V$ is the change in the total output in value terms, $a_{oi}$, $y_{oi}$ and $p_{oi}$ are respectively the area under, the yield rate and the price of the i th crop at the first point and $a_{li}$, $y_{li}$ and $p_{li}$ are respectively the area under, the yield rate and the price of the i th crop at the second point of time and the summation extends over all the crops.

The change in the value of output, $Z_V$, is the sum total of the effects of changes in the three factors that we have selected, namely, area, yield rates and the prices of different crops. This consists of the effects of the variation in each of these factors taken individually (pure effects) which may be denoted as $Z_A$, $Z_Y$ and $Z_P$ and the effects of their simultaneous variation (interaction effects), namely, that of area and yield ($Z_{AY}$), area and price ($Z_{AP}$), yield and price ($Z_{YP}$). The above set of pure effects and interaction effects can be verified as mutually exclusive. They also explain the variation in the value of output in full.

2. "Growth of Agriculture in the Punjab During the Decade 1952-62," *Indian Journal of Agricultural Economics*, Vol. XX, No. 3, July-September, 1965.

It is possible to estimate the contribution towards $Z_V$ due to change in each of the three factors as under by assuming every time, the other two factors as constant.

$$Z_A = \sum_i (a_{li} - a_{oi})\ y_{oi}\ p_{oi}.$$

$$Z_Y = \sum_i (y_{li} - y_{oi})\ a_{oi}\ p_{oi}.$$

$$Z_P = \sum_i (p_{li} - p_{oi})\ a_{oi}\ y_{oi}.$$

By analogy, the changes due to interaction effects can be estimated by the use of the following formulae :

$$Z_{AY} = \sum_i (a_{li} - a_{oi})\ (y_{li} - y_{oi})\ p_{oi}.$$

$$Z_{AP} = \sum_i (a_{li} - a_{oi})\ (p_{li} - p_{oi})\ y_{oi}.$$

$$Z_{YP} = \sum_i (y_{li} - y_{oi})\ (p_{li} - p_{oi})\ a_{oi}.$$

$$Z_{AYP} = \sum_i (a_{li} - a_{oi})\ (y_{li} - y_{oi})\ (p_{li} - p_{oi}).$$

If, therefore, we were to estimate the total contribution of each of the factors towards the change in agricultural output it will be necessary to estimate, in addition to the pure effect, the interaction effect ascribable to each of the factors in the simultaneous variations. An easy way to do this would be to apportion the effect of simultaneous variation ($Z_{AY}$, $Z_{AP}$, etc.) in proportion to the value of the pure effect of the concerned variable. Thus in the case of $Z_{AY}$, $Z_{AP}$ and $Z_{AYP}$, (the interaction effects) the change ascribable to area (denoted by $Z_{A.Y}$, $Z_{A.P.}$ and $Z_{A.YP}$) will be as under:

$$Z_{A.Y} = Z_{AY} \left[ \frac{Z_A}{(Z_A + Z_Y)} . \right]$$

$$Z_{A.P} = Z_{AP} \left[ \frac{Z_A}{(Z_A + Z_P)} . \right]$$

$$Z_{A.YP} = Z_{AYP} \left[ \frac{Z_A}{(Z_A + Z_Y + Z_P)} . \right]$$

Similarly, $Z_{Y.A}$, $Z_{Y.P}$, $Z_{Y.AP}$, $Z_{P.A}$, $Z_{P.Y}$ and $Z_{P.AY}$ can all be estimated.

The total effect of changes in area would then be $Z_A + Z_{A.Y} + Z_{A.P} + Z_{A.YP}$, of changes in yield $Z_Y + Z_{Y.A} + Z_{Y.P} + Z_{Y.AP}$ and of changes in price $Z_P + Z_{P.A} + Z_{P.Y} + Z_{P.AY}$.

*Changes in Output due to Changes in Cropping Pattern*

Changes in total output due to changes in area under individual crop as mentioned earlier, consists of those due to (i) changes in the total sown area ($Z_S$) and (ii) changes in the cropping pattern ($Z_C$).

Thus $Z_A = (Z_S + Z_C)$

The changes due to cropping pattern in the pure effect of area changes would therefore be :

$$Z_C = Z_A - Z_S$$

$$= \sum_i (a_{li} - a_{oi} \frac{A_I}{A_O})\ y_{oi}\ \ p_{oi}$$

where $Z_S$ is the change in output that would have taken place if there was a mere change in area and no change in cropping pattern, $Z_C$ is the change due to cropping pattern and $A_O$ and $A_I$ are respectively the changes in the total sown area under all crops at the first and second point of time.

This does not, however, explain the effect of cropping pattern changes associated with the interaction effect of changes in the area. This can be further estimated by another assumption that the effect of changes in the cropping pattern is in the same proportion as that of the pure effect. The total effect of cropping pattern changes can then be estimated as :

$$Z_C + \frac{(Z_{A.Y} + Z_{A.P} + Z_{A.YP})\, Z_C}{Z_A} .$$

P. V. JOHN*

## ECONOMIC POTENTIALITIES OF VEGETABLE CULTIVATION ON SULLAGE WATER FARMS IN PUNJAB (A CASE STUDY)

Increasing industrialization and urbanisation in India is generating more and more purchasing power in the urban centres, which along with shortage of foodgrains is bringing about some shifts in the food consumption patterns, in favour of vegetables—a more nutritive and protective food. This increase in the demand for vegetables has led to a considerable increase in the area and production of vegetable crops. But vegetable crops are highly perishable and require immediate market. The vegetable area, therefore, increased near the cities mainly and in the suburbs of most of cities the farmers have shifted to vegetable cultivation.

The availability of sullage water around the cities has also played a great role in promoting vegetable cultivation due to the richness of sullage water in plant nutrients. Ordinary crops like wheat, maize, rice would not stand to heavy concentration of plant nutrients and would lodge. Since sullage water supplies are continuous, growing of crops other than vegetables would not use the available nutrients fully due to low intensity. Vegetables have good potential to increase intensity even upto 400 to 500 per cent. This high intensity of cropping makes full use of the supply of plant nutrients through sullage water.

Vegetable crops are short duration crops, allowing enough scope for increasing the intensity of cropping. Around the city some progressive farmers are raising 4 to 5 crops in a year. There is thus much of a flexibility in adjusting vegetable crop rotations. Within the vegetable crops group, some crops are more income bright and the others less. Keeping in view the high fertility of suburban land and some complementary and supplementary effect of vegetable crops, these crops can be fitted into profitable rotations resulting in increasing farm income, and production planning on vegetable farms should be based on these rotations rather than individual crop enterprises.

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This study attempts to examine the economic potentials of different vegetable crop rotations on a representative farm in the vicinity of Ludhiana city, served with the sullage water.

The specific objectives of the study are : (1) to estimate the optimum combination of different vegetable crops (rotational basis) so as to maximize the returns to fixed farm resources; (2) to work out the marginal value productivity of different farm resources, so as to spot out the bottleneck resources and locate surpluses.

One of the demonstration farms operated by the Department of Economics and Sociology, growing vegetable and served with sullage water was selected purposively for this study. The data on resource availability, input-output coefficients for different vegetable crop enterprises were obtained through conference with the cultivator and records maintained by the Department. Linear programming technique of farm management analysis was used to optimize the returns to fixed farm resources.

For the purpose of the analysis, land was classified according to land use capabilities after surveying the farm and discussion with the cultivator. Land was classified under six categories: (1) Summer arable crops and fodder land; (2) Summer vegetable and fodder land; (3) Autumn fodder and arable crops land; (4) Autumn vegetable land; (5) Spring arable crops and fodder land; and (6) Spring vegetable land.

*Selection of Rotations*

In order to locate the optimum production pattern for the farm all possible vegetable rotations were examined. The farmer was already following the rotations having 400-500 per cent intensity. It was, therefore, preferred to include the rotations already followed by the farmer. The different rotations selected were as shown in Table I.

TABLE I—COSTS AND RETURNS OF DIFFERENT CROP ROTATIONS ON THE SELECTED FARMER FIELDS, LUDHIANA SUBURBAN AREA: 1966-67

| | Rotations | Variable costs (Rs.) | Returns to fixed farm resources (Rs.) |
|---|---|---|---|
| 1. | Maize fodder→Potatoes Autumn→Sarson green→Potatoes Spring→Maize fodder .. .. .. .. .. .. | 2,441.67 | 4,998.33 |
| 2. | Cauliflower→Potatoes Autumn→Sarson green→Potatoes Spring→Maize fodder .. .. .. .. .. .. | 3,501.35 | 4,938.65 |
| 3. | Cauliflower early→Cauliflower Autumn→Potatoes Spring→Maize fodder .. .. .. .. .. .. .. | 3,609.38 | 4,190.62 |
| 4. | Maize fodder→Cauliflower Autumn→Potatoes Spring→Maize fodder .. .. .. .. .. .. .. | 2,319.34 | 3,480.66 |
| 5. | Maize fodder→Potatoes Autumn→Tomatoes+Coriander, etc. | 2,988.12 | 4,011.88 |
| 6. | Cauliflower early→Potatoes Autumn→Tomatoes+Coriander, etc. .. .. .. .. .. .. .. | 4,047.80 | 3,952.20 |

*(Contd.)*

TABLE I—(*Concld.*)

| Rotations | Variable costs (Rs.) | Returns to fixed farm resources (Rs.) |
|---|---|---|
| 7. Maize fodder→Cauliflower Autumn→Tomatoes+Coriander, etc. .. .. .. .. .. .. .. | 2,874.09 | 3,125.91 |
| 8. Cauliflower→Cauliflower Autumn→Tomatoes+Coriander, etc. | 4,164.13 | 3,835.87 |
| 9. Maize fodder→Potatoes Autumn→Tomatoes + late Cauliflower or Cabbage .. .. .. .. .. .. | 2,378.79 | 4,821.21 |
| 10. Cauliflower→Potatoes Autumn→Tomatoes + late Cauliflower | 3,438.57 | 4,761.43 |
| 11. Cauliflower→Cauliflower Autumn→Tomatoes+Cabbage .. | 3,628.83 | 3,971.17 |
| 12. Cauliflower→Cauliflower Autumn→Cucurbit→Maize fodder | 3,155.92 | 3,144.58 |
| 13. Cauliflower→Potatoes Autumn→Cucurbits→Maize fodder .. | 3,039.59 | 3,260.41 |
| 14. Maize fodder→Potatoes→Cucurbits→Maize fodder .. | 1,979.91 | 3,320.09 |
| 15. Maize fodder→Cauliflower→Cucurbits→Maize fodder .. | 1,865.88 | 2,434.12 |
| 16. Paddy T.N. 1→Wheat Mex.→Maize fodder .. .. | 493.26 | 3,152.74 |
| 17. Paddy→Berseem .. .. .. .. .. .. .. | 445.35 | 1,930.65 |

*Capital Borrowing Activities*

Capital borrowing activities were introduced for all the three vegetable growing seasons with a view to assess the additional needs of the farm. Interest was charged at the prevalent rate of 12 per cent per annum.

*Fixed Farm Activities*

Fodder for farm animals and vegetable nursery were considered as fixed activities for this programming analysis. As the fodder is required in all the seasons, the area required for the purpose was put under the following two rotations in order to obtain fodder continuously throughout the year.

1. Maize fodder→Potatoes→Potatoes→Maize fodder.
2. Paddy→Berseem.

The area required for raising fodder and nursery was decided in consultation with the cultivator keeping in view the number of milch and draft animals kept.

*Resource Restrictions*

The most limiting factor of production with the farmer were (i) land and (ii) capital. Restrictions in respect of these resources were therefore introduced in all the three seasons, Considering the risky nature of the vegetable crops and market conditions, the farmer was not in favour of growing any single crop beyond a certain limit. The crop area restrictions were, therefore, imposed as follows :

| | | |
|---|---|---|
| 1. | Cauliflower early maximum .. .. .. .. | 15 acres |
| 2. | Potatoes autumn crop† .. .. .. .. | 15 acres |
| 3. | Potatoes spring crop† .. .. .. .. | 10 acres |
| 4. | Cauliflower autumn crop .. .. .. .. | 15 acres |
| 5. | Cabbage .. .. .. .. | 5 acres |
| 6. | Late cauliflower+cabbage maximum .. .. .. | 5 acres |
| 7. | Tomatoes and brinjals maximum .. .. .. .. | 10 acres |
| 8. | Cucurbits maximum .. .. .. .. | 2 acres |

† These limits are over and above the acreage included in fixed rotation.

*Net Availability of Limited Farm Resources*

Net availabilities of different limited resources for commercial crop enterprises were worked out after deducting the resources requirement of the fixed activity rotations such as maize—potato—potato and paddy—berseem. The net availability of the farm resources is shown in Table II.

TABLE II—NET AVAILABILITY OF FARM RESOURCES

| Category | Total availability | Reserved for fodder rotations (fixed activity) | Reserved for nursery raising | Net available for commercial crops |
|---|---|---|---|---|
| A. Land (acres) | | | | |
| 1. Summer arable crops and fodder crops land | 31.81 | 2.4 + 1.6 = 4.0 | 0.75 | 27.06 |
| 2. Summer vegetable and fodder land | 19.62 | 2.4 | 0.75 | 16.47 |
| 3. Autumn arable crops and fodder land | 31.81 | 1.6 + 2.4 | 0.75 | 27.06 |
| 4. Autumn vegetable land .. .. | 19.62 | 2.49 | 0.75 | 16.47 |
| 5. Spring arable crops and fodder land | 31.81 | 1.6 + 2.4 | 0.75 | 27.06 |
| 6. Spring vegetable land .. .. | 19.62 | 1.6 | 7.75 | 16.47 |

| | Total availability | Required for cattle rearing | Required for nursery raising | Required for fodder growing rotations | Net availability |
|---|---|---|---|---|---|
| B. Capital (Rupees) | | | | | |
| 1. Summer season capital | 10,430 | 119.24 | 276.00 | 566.40 | 9,468.36 |
| 2. Autumn season capital | 13,245 | 118.30 | 273.00 | 1,512.52 | 11,341.50 |
| 3. Spring season capital | 17,000 | 236.60 | 546.00 | 3,546.00 | 13,129.40 |

*Comparative Enterprise Budgets*

The enterprise budgets for different vegetable crops and combinations of different vegetable crops were prepared on the basis of expected yields and prices based on previous records and experience of the cultivator. These enterprise budgets of individual crops and their combinations were adjusted into different rotations to work out the costs and returns of different rotations as shown in Table I.

*Results and Discussion*

The existing farm organization for the year 1966-67 included 12.31 acres under cauliflower, 5 acres under maize fodder, 11 acres under paddy, 1.62 acres under pasture and 0.82 acre under spinach in the summer season. In the previous years more area was left under pasture. But with the introduction of new heavy yielding varieties of paddy, *viz.*, Taichung Native I the area under pasture was decreased. Pasture was planned to be eliminated from the production plan for the next year.

In Autumn season 13 acres were put under potatoes, 3.94 acres under cauliflower, 6.44 acres under berseem, 6.19 acres under Mexican wheat and 1.19 acres under coriander. After potatoes, sarson green was cultivated in 3.94 acres. Earlier no sarson green crop was taken after Autumn potatoes crop. It is only during 1966-67 that this new crop was introduced in between two crops of potatoes which increased the intensity of cropping to 500 per cent (rotation being maize→potato→sarson→potato→maize). The acreage under this rotation would be increased next year.

In Spring season 10.50 acres of the area was put under potatoes to be followed by maize fodder crop. Tomatoes and late cauliflower crop and cabbage occupied 2.87 acres. Tomatoes + coriander accounted for 1.06 acres, brinjals + coriander 0.50 acre, brinjals + onions 0.50 and brinjals occupied 0.75 acre. Berseem, wheat and coriander crop occupied the land in Spring season also, accounting for 6.44 acres, 6.19 acres and 1.19 acres respectively.

In all the three seasons, 1.06 acres were left for raising of nursery for various vegetable crops. In certain periods (such as February, March) when no nursery for any crop was needed, this area was diverted to some short duration vegetables which could be used for home consumption.

Based on the existing cropping plan, the returns to fixed farm resources were calculated at Rs. 90,816.65. The returns to fixed farm resources per acre thus worked out to be Rs. 2,854.97.

*Optimum Farm Organization*

The final iteration of simplex solution indicated that the following three rotations were the most profitable ones.

(i) Maize fodder→Potatoes→Sarson→Potatoes→Maize fodder.
(ii) Maize fodder→Potatoes→Tomatoes + late Cauliflower or Cabbage.
(iii) Paddy→Wheat→Maize fodder.

The analysis suggests that 10 acres should be put under rotation (i), 5 acres under rotation (ii), and 12.06 acres under rotation (iii). Besides these rotations, 1.6 acres would need to be put under rotation paddy→berseem and 2.4 acres under maize→potatoes→potatoes→maize fodder as fixed activities to produce fodder for farm animals.

The break-down of these rotations gave the following optimum plan. The optimum farm plan suggests that in Summer season it would pay to increase the maize fodder acreage to 17.40 as against 5 acres in the existing plan. Paddy crop would be sown on 13.66 acres as against 11 acres in the existing plan. Cauliflower, pasture and spinach is discouraged in the optimum plan and their cultivation is not suggested.

In Autumn season, area under potatoes would increase to 17.40 acres. It would include 10 acres under potatoes followed by sarson and 7.40 acres under potatoes followed by any other Spring crop. Due to higher income from Mexican wheat, its area would increase to 12.06 acres. Wheat would be followed by maize fodder in May-June. Berseem would be discouraged and only 1.60 acres under berseem required for fodder would be included in the optimum plan.

In Spring season, optimum plan suggested 12.4 acres to be put under potatoes to be followed by maize fodder; 5 acres got allotted to tomatoes intercropped with late cauliflower or cabbage. Wheat and berseem would continue from Autumn season on 12.06 and 1.60 acres respectively.

The analysis showed that the optimum plan so outlined yielded higher returns to the fixed farm resources, compared to returns from the existing farm plan. Net absolute gains and percentage increase in the farm income were obtained as under :

| | Rs. P. |
|---|---|
| Returns to fixed farm resources in the existing plan .. .. .. | 90,816.65* |
| Returns to fixed farm resources in the optimum plan .. .. .. | 1,17,907.92* |
| Gain .. .. .. .. .. .. .. .. | 27,091.27 |
| Percentage gain .. .. .. .. .. .. .. .. | 29.83 |
| Returns per acre in the optimum plan .. .. .. .. .. | 3,706.63 |

* As vegetable crops are more risky ones and much affected by the adverse weather conditions, insect pests and diseases attack, these returns are liable to be reduced by 25 per cent under such conditions.

This increase came through changes in product mix, which included more area of maize fodder, paddy, potatoes Autumn, tomatoes and late cauliflower or cabbage.

*Resource Use Pattern and Demand for Additional Resources*

The resource use pattern of the farm brought out that land and Spring season capital were the most limiting farm resources. Land was fully utilized in all the seasons. Land fit for vegetables was however surplus to the extent of 1.47 acres which was put under arable crops. This showed that vegetable farms would be essentially small farms, because of more risky nature of vegetable crops and heavy capital input. The Summer season capital and Autumn season capital were in surplus to the tune of Rs. 5,898.25 and Rs. 4,015.24 respectively.

The introduction of capital borrowing activities indicated that the farmer would need to borrow Rs. 7,560.49 in Spring season as a short term seasonal loan or he should utilize the surplus capital of other two seasons.

The analysis showed that the overall capital requirement and gross availability of capital for the whole year were as shown in Table III.

TABLE III—OVERALL REQUIREMENT AND GROSS AVAILABILITY OF CAPITAL

| Category | Capital requirement | Gross availability (including capital required to raise fixed activities) | Surplus (+) or deficit (—) |
|---|---|---|---|
| 1. Summer season capital (Rs.).. .. | 4,531.75 | 10,430.00 | + 5,898.25 |
| 2. Autumn season capital (Rs.).. .. | 9,229.76 | 13,245.00 | + 4,015.24 |
| 3. Spring season capital (Rs.) .. .. | 24,460.49 | 17,000.00 | — 7,460.49 |
| Total .. | 39,222.00 | 40,675.00 | + 1,453.00 |

Capital required in the optimum plan for the whole year thus amounted to Rs. 39,222 whereas capital available with the farmer was Rs. 40,675. This shows that capital was surplus with the farmer amounting to Rs. 1,453 which could be utilized for making some permanent investment on the farm such as purchase of labour-saving machinery.

*Marginal Value Productivity of Different Farm Resources*

The productivity of resource depends upon its supply relative to the supply of other resources on the farm, which are needed in combination for taking up an enterprise or combination of enterprises. The productivity of resources, therefore, is an outcome of a specific farm situation in respect of its resource mix and enterprise combination.

Column $Z_j - C_j$ of the answer iteration indicated the marginal value productivity of different farm resources. The marginal value productivity of Summer land fit for arable and fodder crops was Rs. 3,061.52 indicating a high rental value of land on this farm. It means, it pays to the cultivator to rent in an additional acre of land at Rs. 3,061.52. Similarly, opportunity costs of different crop maximum indicated that it would pay to the farmer to raise the acreage maximum of these crops with the following returns:

| Crop maximum | Amount per acre (Rs.) |
|---|---|
| Autumn potatoes maximum .. .. .. .. .. .. | 559.26 |
| Late cauliflower or cabbage maximum .. .. .. .. .. | 452.76 |

From the analysis of the marginal value productivity of different resources, it is evident that Summer season capital and Autumn season capital have zero opportunity costs and thus are in excess. It is thus profitable that this excess capital should be utilized in Spring season where capital is limited. The marginal value productivity of Spring season capital is Rs. 1.06, so the capital should be acquired at a rate not exceeding 6 per cent for this season or the surplus capital of Summer and Autumn season should be utilized in Spring season.

*Conclusion*

Based on this case study of a progressive sullage water vegetable farm, following conclusions can be drawn :

(1) As vegetable cultivation requires heavy capital input and is risky in nature, a vegetable farm could be essentially a small farm. If the farm is large in size, beyond certain area limits (say 18 acres) arable crops would enter the product mix.

(2) At the prevalent product and supplies prices, most profitable vegetable crop rotations would be :

(i) Maize fodder→Potatoes→Sarson green→Potatoes→Maize fodder.
(ii) Maize fodder→Potatoes→Tomatoes+late Cauliflower or Cabbage.

The rotation "paddy—wheat—maize fodder" is more paying compared with rotation "paddy—berseem," on arable crop lands.

(3) Maize fodder and paddy are more paying in Summer season. Cauliflower affects the returns from succeeding potato crop adversely to render it comparatively unprofitable. In Autumn season it pays to increase the acreage under potatoes and wheat. Cauliflower and berseem cultivation is not that profitable under such farm situations.

In Spring season potatoes followed by a maize fodder crop and tomatoes inter-cropped with late cauliflower or cabbage are comparatively more profitable enterprises.

(4) It is possible to enhance the returns to fixed farm resources to the tune of over 29 per cent over the returns from the existing production plan through rationalization of resource use alone even on progressive farms in the suburbs of the cities.

O. P. SAHNI

AND

S. S. JOHL*

## EVALUATION OF INTENSIVE AGRICULTURAL DISTRICT PROGRAMME—A CASE STUDY FOR WHEAT IN LUDHIANA DISTRICT†

The Intensive Agricultural District Programme (I.A.D.P.) was initiated in seven districts of India in 1961 (later extended to cover one district in each State) with a view to attain a rapid rate of growth in agricultural production in these districts. An attempt has been made in this paper to suggest a model for evaluating the impact of the I.A.D.P. on the productivity of important crops. The model has been put to test with the help of data on wheat crop in Ludhiana district for the years 1962-63 to 1965-66.

There are many ways in which the impact of the I.A.D.P. activities could be studied. At the aggregate level, one could study changes in aggregate production in the district over time. Using some price weights one could generate estimates of aggregate income and study changes therein. Another measure could be to study changes in yield rates for the major crops grown in the districts. We have concentrated on the study of the yield rates over time in our analysis. Since the I.A.D.P. activities have primarily concentrated on the technical aspect of increasing yields of important crops, changes in yield rates provide a ready reckoner of the impact of the programme. Moreover, if the cropping pattern does not alter substantially over time, change in yield rates of important crops also reflects the trends in aggregate production.

### *The Model*

The principal measures for bringing about an increase in yield rates can be grouped into two broad categories :

(*a*) Streamlining the supplies of modern inputs of production such as improved seeds, fertilizers, pesticides, etc., and

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† The views expressed are the personal views of the author.

(*b*) Improving the managerial ability of the farmer through extension efforts so that the farmers are able to improve productivity per unit of inputs.

In addition to the above two factors a major force influencing the yield of crops in our country is weather. If we let :

$Y_o$ = Per acre yield of wheat in year 0,
$X_{io}$ = Per acre dose of i th input in year 0,
$W_o$ = Weather complex in year 0.

Then,

$$Y_o = f_o\,(X_i)_o + u \qquad i = 1, \;........ n \tag{1}$$

$$Y_1 = f_1\,(X_i)_1 + v \qquad i = 1, \;........ n \tag{2}$$

$$Y_1 - Y_o = f_1\,(X_i)_1 = f_o\,(X_i)_o + (v - u) \tag{3}$$

or $$Y_1 - Y_o = f_1\,(X_i)_1 - f_o\,(X_i)_1 + f_o\,(X_i)_1 - f_o\,(X_i)_o + (v - u) \tag{4}$$

or $$\triangle Y = \triangle Y_{\triangle f} + \triangle Y_{\triangle x_i} + (v - u) \tag{5}$$

where, $\triangle Y = Y_1 - Y_o$

$$\triangle Y_{\triangle f} = f_i\,(X_i)_1 - f_o\,(X_i)_1$$

$$\triangle Y_{\triangle x_i} = f_o\,(X_i)_1 - f_o\,(X_i)_o.$$

It may be seen that change in yield from one year to another ($\triangle Y$) can be explained through :

(*a*) change in yield due to change in the efficiency of resource use, assuming input levels to remain unchanged ($\triangle Y_{\triangle f}$),

(*b*) change in yield due to change in the level of inputs, assuming efficiency of resource use to remain unchanged ($\triangle Y_{\triangle x_i}$) ; and

(*c*) change in yield caused by change in weather complex ($\triangle Y_{\triangle w}$) and other unknown causes.

In real world situation the impact of change in yield due to change in the efficiency of resource use ($\triangle Y_{\triangle f}$) alone is difficult to estimate. Such an estimated change ($\triangle Y_{\triangle f}$) reflects the impact of change in weather and other factors also in addition to change in efficiency of resource use. To estimate the contribution of each factor separately is difficult. We have attempted to estimate change in yield due to change in weather complex ($\triangle Y_{\triangle w}$) on the basis of Rao's model.[1] Change in yield ($\triangle Y$) has thus been broken into three components :

1. B. M. Rao, "A Study of the Effect of Some Weather Factors on the Yield of Wheat in Ludhiana District, Punjab," The Silver Jubilee Number of the *Indian Journal of Agricultural Economics*, Vol. XIX, Nos. 3 and 4, July-December, 1964.

$$\triangle Y = \triangle Y_{\triangle x} + \triangle Y_{\triangle f} + \triangle Y_{\triangle w} \quad (6)$$

$$\text{or } \triangle Y_{\triangle f} = \triangle Y - \triangle Y_{\triangle x} - \triangle Y_{\triangle w} \quad (7)$$

It may thus be seen that the impact of the programme on the efficiency of resource use is measured by way of a residual. This residual in fact may reflect the contribution of some other unknown factors also. But by giving the benefit of doubt to the I.A.D.P., the residual is taken to reflect the impact of the programme alone on the efficiency of resource use. Another limitation of the model presented above lies in its inability to take into account the qualitative changes either in a single input or in the package of inputs. For instance, the model is not able to take cognizance of the replacement of existing varieties by high yielding varieties.

*The Data*

The data for the present study have been taken from the crop cutting experiments conducted each year on wheat crop in Ludhiana district. About 300 crop cuts are taken every year on each of the major crops in the district. Besides recording the yield level, information is also obtained on the level of inputs used and cultural operations performed by the investigators. Information is available on the following input items :

(*a*) Quantity of nitrogenous fertilizers,
(*b*) Quantity of phosphatic fertilizers,
(*c*) Quantity of potassic fertilizers,
(*d*) Quantity of farmyard manure, green manures and other organic manures,
(*e*) Number of irrigations,
(*f*) Date of sowing,
(*g*) Seed rate,
(*h*) Number of ploughings,
(*i*) Use of insecticides and pesticides, and
(*j*) Damage to the crop due to the various natural and other hazards.

The data for 1961-62 have not been used in the present analysis since it was the first year of the operation of the programme and there were some gaps in the data. The variables considered in the study are :

Y = Yield of wheat in quintals per acre
N = Pounds of nitrogen per acre
P = Pounds of phosphoric acid per acre
K = Pounds of potash per acre
I = Number of irrigations
$P_1$ = Number of ploughings
SR = Seed rate in kilogrammes per acre
DS = Date of sowing. Rankings of 1, 2 and 3 were given to the date of sowing depending on whether the crop was sown before the normal sowing season or during the normal sowing season or after the normal sowing season.

*The Results*

Several equations with linear and quadratic terms of the variables discussed above were fitted to the data. The results of two equations that fitted the data best and where the signs of the coefficients are in conformity with agronomic logic are presented in Tables I and II.

A perusal of the results presented in these tables indicates that the variables considered in the analysis are not able to explain a large proportion of the variance in yield. The signs of some of the coefficients are also not consistent with agronomic logic. Notwithstanding these limitations an attempt has been made to apportion the observed change in wheat yield per acre as between different years among different components. The results of the analysis are presented in Tables III and IV.

A perusal of these tables indicates that as compared to the base year, *i.e.*, 1962-63, the yield of wheat went up in all the subsequent years. The data show a decline in yield as between 1964-65 and 1965-66. A look at the factors contributing to change in yield indicates that about 1/3 to 1/2 of the observed change in yield over the base year can be explained by the changes in the level of inputs utilized. It may also be noted that the change in yield due to change in the level of inputs is positive for any two years for which comparison may be made (with the exception of change in yield due to change in inputs as between 1963-64 and 1965-66 for function 2). This indicates that the I.A.D.P. has been successful in motivating farmers to use higher levels of inputs. The change in yield due to the change in the efficiency of the resource use as reflected by $\triangle Y_{\triangle f}$ also turns out to be positive for all the years as compared to the base year. It is interesting to note that the proportion of change in yield that may be ascribed to change in the efficiency of resource use goes up over the years as compared to the base year. There is no consistency in the results for the later years. However, it is safe to infer that the programme has been able to improve the managerial skills of the farmers.

*Summary*

The Intensive Agricultural District Programme was initiated in 1961 to attain a rapid rate of growth in agricultural production in the selected districts. There has been a great deal of argument about the success of the programme. A model has been formulated to evaluate the impact of the programme. The data from crop cutting experiments on wheat in Ludhiana district have been utilized to study the impact of the programme and the factors affecting changes in yield rates. It appears that as a result of the programme farmers are using higher levels of inputs on an aggregate. The results of the study further indicate that there has been some improvement in the managerial skills of the farmers as reflected in aggregate productivity of resources.

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TABLE I—FACTORS AFFECTING YIELD OF WHEAT IN LUDHIANA

$(Y=a+b_1 N+b_2 I+b_3 P_1+b_4 DS+b_5 SR+b_6 I^2)$

| Dependent variable | 1962-63 | | | 1963-64 | | | 1964-65 | | | 1965-66 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ |
| N | 24.6 | 0.0092** | 0.0043 | 19.9 | −0.0039 | 0.0050 | 18.0 | 0.0278** | 0.0107 | 18.9 | 0.0395*** | 0.0089 |
| I | 3.7 | 0.5573 | 0.3783 | 4.5 | 1.3643*** | 0.4415 | 4.3 | 0.6175 | 0.4318 | 4.7 | 0.9632* | 0.4918 |
| $P_1$ | 4.9 | 0.0859 | 0.0563 | 5.1 | 0.0111 | 0.0558 | 4.7 | 0.1794** | 0.0740 | 4.7 | 0.0621 | 0.0701 |
| DS | 2.1 | —0.3244 | 0.2366 | 2.0 | 0.0200 | 0.2128 | 2.1 | —0.3577 | 0.2556 | 2.1 | —0.1140 | p.3057 |
| SR | 31.10 | 0.0626** | 0.0227 | 33.8 | 0.1425*** | 0.0305 | 35.3 | 0.0739** | 0.0305 | 34.9 | −0.0274 | 0.0327 |
| $I^2$ | 15.3 | −0.0137 | 0.0464 | 21.7 | −0.0962** | 0.0468 | 20.2 | 0.0074 | 0.0478 | 24.2 | −0.0642 | 0.0507 |
| Y | 8.07 | | | 9.10 | | | 10.4 | | | 9.74 | | |
| $R^2$ | 0.154 | | | 0.206 | | | 0.232 | | | 0.121 | | |
| a | 4.3110 | | | 0.2534 | | | 4.1361 | | | 6.8831 | | |
| $F(n_1, n_2)$ | 9.414*** (6,309) | | | 12.7398*** (6,295) | | | 14.3380*** (6,285) | | | 7.2261*** (16,315) | | |
| Number of observations | 316 | | | 302 | | | 292 | | | 322 | | |

* Indicates significance at 10 per cent level of significance.

** Indicates significance at 5 per cent level of significance.

*** Indicates significance at 1 per cent level of significance.

TABLE II—FACTORS AFFECTING YIELD OF WHEAT IN LUDHIANA

$(Y = a + b_1 N + b_2 P + b_3 K + b_4 I + b_5 P_1 + b_6 DS + b_7 SR + b_8 DS^2 + b_9 I^2)$

| Dependent variable | 1962-63 | | | 1963-64 | | | 1964-65 | | | 1965-66 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ | $X_i$ | b | $\sigma_b$ |
| N | 24.6 | 0.0138 | 0.0095 | 18.9 | 0.0098 | 0.0172 | 18.0 | 0.0386** | 0.0169 | 18.9 | 0.0503** | 0.0135 |
| P | 11.5 | 0.0947*** | 0.0192 | 10.3 | 0.0985*** | 0.0327 | 7.5 | 0.0308 | 0.0245 | 4.8 | 0.0949*** | 0.0300 |
| K | 18.5 | −0.0533*** | 0.0099 | 15.3 | −0.0586*** | 0.0163 | 6.0 | −0.0293* | 0.0159 | 5.0 | −0.0594*** | 0.0163 |
| I | 3.7 | 0.4319 | 0.3640 | 4.5 | 1.3045*** | 0.4347 | 4.3 | 0.5748 | 0.4321 | 4.7 | 0.7071 | 0.4902 |
| $P_1$ | 4.9 | 0.0894 | 0.0543 | 5.1 | −0.0256 | 0.0564 | 4.7 | 0.1823** | 0.0741 | 4.7 | 0.0605 | 0.0690 |
| DS | 2.1 | 0.1083 | 0.8120 | 2.0 | −0.5137 | 0.4847 | 2.1 | −0.5381 | 0.9076 | 2.1 | 0.3893 | 1.2810 |
| SR | 31.0 | 0.0353 | 0.0227 | 33.8 | 0.1102*** | 0.0314 | 35.3 | 0.0674** | 0.0308 | 34.9 | −0.0415 | 0.0325 |
| $DS^2$ | 4.5 | −0.1129 | 0.1762 | 4.5 | 0.0559 | 0.0589 | 4.8 | 0.0351 | 0.1863 | 4.6 | −0.0894 | 0.2564 |
| $I^2$ | 15.3 | −0.0006 | 0.0446 | 21.7 | −0.0933* | 0.0461 | 20.2 | 0.0102 | 0.0478 | 24.2 | −0.041 | 0.0504 |
| Y | 8.07 | | | 9.10 | | | 10.14 | | | 9.74 | | |
| $R^2$ | 0.231 | | | 0.241 | | | 0.241 | | | 0.158 | | |
| a | 4.7885 | | | 2.2004 | | | 4.4378 | | | 6.9679 | | |
| $F(n_1, n_2)$ | 10.2183 (9,306) | | | 10.3015 (9,292) | | | 9.9736 (9,282) | | | 6.4874 (9,312) | | |
| Number of observations | 316 | | | 302 | | | 292 | | | 322 | | |

* Indicates significance at 10 per cent level.
** Indicates significance at 5 per cent level.
*** Indicates significance at 1 per cent level.

TABLE III—CHANGE IN WHEAT YIELD IN LUDHIANA DISTRICT

$(Y=a+b_1 N+b_2 I+b_3 P_1+b_4 DS+b_5 SR+b_6 I^2)$

| | 1963-64 | | | | 1964-65 | | | | 1965-66 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\Delta Y_{\Delta X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ | $\Delta Y_{\Delta X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ | $\Delta Y_{X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ |
| 1962-63 | 53 | 24 | 26 | 103 | 46 | 10 | 151 | 207 | 61 | −7 | 113 | 167 |
| 1963-64 | | | | | 9 | −14 | 109 | 104 | 19 | −31 | 76 | 64 |
| 1964-65 | | | | | | | | | 27 | −17 | −50 | −40 |

Yield is in lbs. per acre

$\Delta Y$ = Change in yield between any two years.

$\Delta Y_{\Delta X}$ = Change in yield due to change in the level of inputs.

$\Delta Y_{\Delta W}$ = Change in yield due to change in the weather complex.

$\Delta Y_{\Delta f}$ = Change in yield due to change in efficiency of resource use.

TABLE IV—CHANGE IN WHEAT YIELD IN LUDHIANA DISTRICT

$(Y=a+b_1 N+b_2 P+b_3 K+b_4 I+b_5 P_1+b_6 DS+b_7 SR+b_8 DS^2+b_9 I^2)$

| | 1963-64 | | | | 1964-65 | | | | 1965-66 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\Delta Y_{\Delta X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ | $\Delta Y_{\Delta X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ | $\Delta Y_{\Delta X}$ | $\Delta Y_{\Delta W}$ | $\Delta Y_{\Delta f}$ | $\Delta Y$ |
| 1962-63 | 43 | 24 | 36 | 103 | 55 | 10 | 142 | 207 | 54 | −7 | 120 | 167 |
| 1963-64 | | | | | 28 | −14 | 90 | 104 | −10 | −31 | 105 | 64 |
| 1964-65 | | | | | | | | | 22 | −17 | −45 | −40 |

## P. L. 480 FOOD AID TO INDIA†

Among the developing nations, India has received a large quantum of food aid from the United States. The Public Law 480 (Food for Peace) programme of the United States has played a significant role in helping India meet her food needs. The first (P.L. 480) Agreement was signed in 1956. Prior to the enactment of this law in 1954, India received two loans of food aid from the United States in 1951. Between 1956 and 1966, India concluded a total of nine agreements with the U.S. As the legislation had to be renewed every two years after 1964, the U.S. Congress passed legislation in 1966 extending the P.L. 480 Act upto 1968. The amendment effected substantial modifications to the programme. Under the amended law, a new agreement which is the 12th covering food aid, was signed by India on 20th February, 1967 for the import of two million tons of foodgrains from U.S.A. on concessional terms. The total of foodgrains supplied to India by the United States during the period 1951 to 20th February, 1967, amounted to 50 million tons.[1] The P.L. 480 supplies include 40.9 million tons of wheat, 4.3 million tons of maize and milo (sorghum), 1.7 million tons of rice, 3.2 million bales of cotton, 177,000 tons of soybean oil, 80,000 tons of tallow, 7,200 tons of tobacco and 34,000 tons of dairy products. In addition to this, the United States has announced its intention to provide an additional 3 million tons of foodgrains to India during this year.

A fundamental provision of the P.L. 480 legislation is that commodities are sold for rupee payment; convertibility to dollars is strictly limited. Under the terms of the P.L. 480 agreement, the Government of India deposits in the accounts of U.S. Government with the Reserve Bank of India, rupees equivalent to the dollars paid to U.S. suppliers of agricultural commodities.[2] The total value of commodities provided by the U.S. under the P.L. 480 agreements since 1956 was $ 3,807.2 million or Rs. 2,855.40 crores at the current rate of exchange (Rs. 7.50 = $ 1). However, because most of the rupees had been deposited prior to the devaluation of the rupee in June 1966, it is estimated that the total P.L. 480 sales proceeds deposited by the Government of India will amount to approximately Rs. 1,950 crores. The value of total U.S. economic assistance to India including P.L. 480 food aid is estimated at $ 7,649.7 million or Rs. 5,737.28 crores.

As amended in 1967, the P.L. 480 has four titles. Title I provides for the sale of agricultural commodities on concessional terms. The original Act provided for sales of commodities against payment in currencies of recipient nations, with provision for conversion of a very small portion into dollars for specified purposes. Agreements with India provided for the conversion of 3 per cent of the sales proceeds for certain specified purposes, but in fact less than 0.7 per cent has been converted into foreign exchange. The new amended legislation provides for a transition from sales for foreign currencies to dollar payments to be completed by 1971. Under this provision, the most favourable terms applicable to credit sales

† *Source :* "U.S. Food Aid to India and the New P.L. 480 Legislation," *Backgrounder*, dated May 8, 1967, United States Information Service, Bombay.

1. Another agreement, which is a supplement to the P.L. 480 agreement signed in February, 1967, was concluded on 12th September, 1967 for the supply of one million tonnes of wheat and milo and an additional 70,000 tonnes of vegetable oil and 30,000 bales of extra-long staple cotton. This brings the amount of U.S. foodgrains supplied to India during 1967 to 6.1 million tonnes, and the total since 1951 to 52 million tonnes. The cost of wheat and other commodities supplied to India under the supplemental agreement will amount to $ 86.5 million (Rs. 65 crores).

2. Until 1960, the bulk of these funds (about Rs. 338 crores) were deposited with the State Bank of India. All these funds were subsequently transferred to the Reserve Bank of India.

presently are 20 years for dollar repayment including a two-year grace period with an interest rate of 1 per cent per annum during the grace period and 2.5 per cent thereafter, and 40 years for convertible foreign currency repayment including a 10-year grace period with the same rate of interest of 1 and 2.5 per cent per annum. Not less than 5 per cent of the purchase price is to be payable in dollars or convertible currencies. However, the United States has agreed to accept payment in rupees for the supplies made under the February 1967 agreement. The change in the currency of payment reflects a marked shift in the U.S. agricultural situation because of the dwindling food surplus which has been estimated at 10 million tons in July, 1967.

The P.L. 480 programme has enabled India not only to save foreign exchange expenditures of a large magnitude, but also to provide rupee resources for economic development. The new agreement specifies that 87 per cent of the sales proceeds as compared to an average of 75 per cent in previous P.L. 480 agreements should be returned by the U.S. to the Government of India in grants and loans for economic development—22 per cent as grants and 65 per cent as loans. Out of 22 per cent of the rupees generated by the sale of the commodities granted by the United States to the Government of India, 12 per cent is intended for financing economic development projects and the remaining 10 per cent for programmes emphasizing maternal welfare, child health and nutrition, and family planning. This is the first time since the May 1960 agreement that the United States has given a grant to the Government of India from P.L. 480 funds. Although the loan provision closely resembles that in prior P.L. 480 agreements, the new P.L. 480 agreement lays emphasis on agricultural development and food productivity. A sum equivalent to 5 per cent is reserved for "Cooley" loans to Indian-American joint enterprises and Indian affiliates of U.S. firms as against 6.7 per cent in pre-P.L. 480 agreements. The amount reserved for U.S. Government uses in India has been cut severely from 20 per cent in the September 30, 1965 agreement to 8 per cent, the average for all previous P.L. 480 agreements being 13 per cent.

Grants totalling Rs. 316.5 crores from P.L. 480 funds have mainly financed education and health projects. Projects benefited include the eradication of malaria and smallpox, the establishment of health centres in rural areas, the training of teachers for medical colleges, elementary education, the training of craftsmen, technological education, the construction of national highways, soil and water conservation, the expansion of agricultural credit and the building of foodgrain storage facilities. Loans to the Government of India amounting to Rs. 878.9 crores from P.L. 480 sales proceeds have helped in financing 16 river-valley projects generating hydro-electric power and augmenting irrigational facilities, 11 thermal power projects and a fertilizer factory. Cooley loans amounting to Rs. 58.7 crores from P.L. 480 funds have been extended to nearly 50 Indian-American firms engaged in the manufacture of a wide variety of products including fertilizers, tyres, cement, synthetic rubber, automobile parts, pharmaceuticals, chemicals, plastics, machine tools, diesel engines, refrigeration equipment, electric motors and steel tubes and forgings. A substantial part of the U.S. owned rupees is utilized to promote a number of programmes beneficial to India. These include the exchange of Indian and American scholars, the publication of low cost text-books for college students, the supply of Indian newspapers and periodicals to U.S. libraries, and research in agricultural, medical, educational and social sciences undertaken by a number of universities and other institutions in India.

Titles II and III of the original P.L. 480 legilsation provided for donations of agricultural commodities to help meet famine or other urgent or extraordinary relief requirements and for distribution through voluntary agencies. Donations valued at $ 261.7 million or Rs. 196.27 crores have been given to India under these two titles. The amending Act joined these two titles into new Title II. Under this new Title, the U.S. has agreed to provide through private voluntary agencies an emergency contribution of $ 25 million (Rs. 18.75 crores) worth of food for free distribution to food-short children and expectant mothers in drought-stricken areas of Bihar and Uttar Pradesh and other distressed areas. This food aid is in addition to a total of roughly Rs. 36.75 crores worth of food commodities granted by the United States which have been distributed in India by U.S. voluntary agencies during the year ending 30th June, 1967.

Title III of the new Food for Peace Act provides mainly for barter of U.S. agricultural commodities for certain types of minerals and other products. The new Title IV includes general provisions such as availability of commodities, authorization to set up a programme of farmer-to-farmer assistance in the U.S. Department of Agriculture and other miscellaneous matters.

Under the recent agreement, the Governments of the U. S. and India recognize "the policy of the exporting country to use its agricultural productivity to combat hunger and malnutrition in the developing countries, to encourage these countries to improve their own agricultural production, and to assist them in their economic development;" and "the determination of the importing country to improve its own production, storage and distribution of food products, including the reduction of waste in all stages of food handling." The agreement sets forth the measures that the two Governments will take individually and collectively in furthering the above mentioned policies and which are indicated in the Draft Outline of the Fourth Five-Year Plan. The U.S. aid programme is assisting India's efforts to become self-sufficient in food by the end of the Fourth Plan. Total United States aid for this purpose has exceeded $ 282 million (Rs. 211.5 crores) in foreign exchange and Rs. 246 crores in rupees derived from the sale of U.S. agricultural commodities.