

ECONOMICS OF RICE PRODUCTION UNDER CONDITIONS OF RISK AND CAPITAL SCARCITY

Thesis submitted in part fulfilment of the requirements for the degree of **Master of
Science (Agriculture)** in **Agricultural Economics** to the **Tamil Nadu
Agricultural University, Coimbatore**

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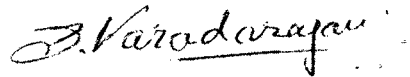
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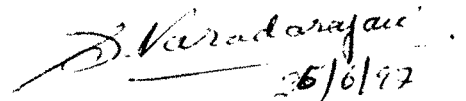


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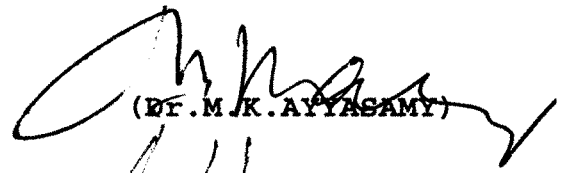
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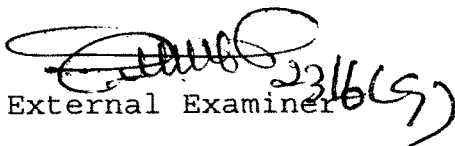
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(**SWAPNAKANTA SAMAL**)

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Introduction

CHAPTER I

INTRODUCTION

In India, rice is the staple food for about two-third of the population and the rest one-third is the wheat eating population. In terms of production, acreage and contribution to the gross agricultural income of the country, it occupies the first position. In 1990-91 the area under rice in India was 42.6 million hectares, but now it has been stabilising around 41.5 m ha, thus constituting about 34.58 per cent of the total area under all food grain crops. It contributed about 45 percent of the total food grain production.

Rice is generally grown in the southern and eastern parts of the country, but in the last few decades rice has been vigorously grown in northern states also. Now Punjab offers the highest per hectare yield of rice with regard to area, production and productivity. There is wide variation in yield of rice among different states of country.

Nearly 60 per cent of the rice area is in Eastern India, but the average yield rate in some of the states of eastern India are even less than half of the rates in the states of northern India. This means that the potentiality - of this sector has not been exhausted so far. Moreover studies reveal that about 35 per cent of the targetted

additional production of 100 million tonnes of food needed by the year 2000 A.D. must be from rice¹.

Orissa is one of the major rice growing states. To a large extent agriculture in Orissa, means growing paddy, which occupies about 44.51 l.ha or 62 percent of the total area under food crops. But production has not shown any appreciable improvements over the decades. The yield rate has been stagnant at around 1000 Kg per hectare during the sixties and the seventies; when national average stood at 1150 Kg. It seems that new rice technology has not produced much impact in Orissa.

The agrarian scenario of Orissa is dominated by marginal and small farmers accounting for 76 per cent of total number of land holders; operating 40 percent of total cultivable land, fragmented over large areas. So land stands as constraint numero uno in augmenting productivity. Moreover data pertaining to rainfall, production of rice and price over last 20 years show a wide coefficient of variation and it reveals that rice production in Orissa is risky, and farmers decision behaviour under risk may be a cause for the low mean yield of rice crop in the state.

1. E.A. Sadiq, "Boosting rice-yields. Focus turns to eastern India". The Hindu Survey of Indian Agriculture, 1988, P-31.

Problem Statement

Using scarce lands to harvest very low yield when the potential yield is very high is tantamount to wasting a national wealth. It should be changed, the sooner the better. Therefore special attention is necessary to identify and relax the binding constraints in rice production. When one of the constraint is risk aversion of the farmers; leading to a conservative production practice, the best way of relaxing the constraint is to develop alternate farm plans for maximising rice yields for different levels of risk and demonstrate optimal production plans to the farmers. Such an exercise has however to take care of varied resource base; and consequence limitations of the use of high pay off inputs and technology. Scarcity of resources can be solved by arranging supplies; but non-responsiveness of the farmers to the technological innovations needs an educational process to build awareness for the available potentials and to promote conviction for optimal decision making. One way of doing it is to develop optimal production plans for different bench mark situations - different size of farms different resource base, different levels of risk and differences in attitude towards risk and demonstrate the possible gains as well as the degrees of risk associated with them. Such an exercise is the aim of this study undertaken in Cuttack district.

Among all the districts of Orissa maximum level of fragmentation is in Cuttack district and its irrigation facility is not well developed. It is further aggravated by high price fluctuation, and competition from cash crops has sought an urgent need to provide normative plans. Such plans have to maximise aggregate net return to the farmers besides taking risk involved in factor use into consideration.

Objective

The overall objective of this study is to understand the decision making behaviour of farmers in rice production. With special attention to the risk and capital scarcity. The specific objectives are

- i. to study the economics of rice production;
- ii. to study the extent of risk and uncertainty in rice production and farmers response to it;
- iii. to evaluate the scarcity of capital if any, its causes, consequences and remedies;
- iv. to develop plans, appropriate to maximise net returns under (a) conditions of risk and (b) assumption of certainty; and
- v. to suggest specific action plans for the farmers and policy support necessary to help them.

Hypothesis

Any attempt to increase the income under uncertain production situation is associated with high risk. In conditions of factor scarcity farmers are normally risk averse. Moreover high risk is associated with high income in all farm size groups. These are the hypotheses to be empirically verified by the study.

Scope of the study

The study is an attempt to identify the risk management behaviour of the paddy farmers in Cuttack district of Orissa. Under the current context of a lower productivity of rice in eastern India as compared to other states of the country the need for stabilisation of income is obvious. The study would suggest programmes to stabilise farmer's income and would also provide appropriate guidelines to farmers to implement the suggested values. The result of analysis of risk in rice production, will help farmers in choice of crop mix that will minimise risk for the expected level of net aggregate farm income. To the risk averse farmers it will be a source of confidence building.

Limitation of the Study

The study is confined only to Cuttack district of Orissa, and it is therefore not fully representative of the state; but it represents the general situation. Therefore conclusion drawn is to be used with caution, while

generalising the figures for the state as a whole. Further the collection of data for cost of cultivation or rice has its obvious recall bias though adequate care has been taken to minimise the recall bias. Hence the results of the study is to be interpreted with the above limitations in view.

Organisation of the thesis

The thesis is organised into the following chapters.

ChapterI Introduction

It consists of description of rice as the most important crop, problem statement, the objectives, the hypothesis, scope and limitations of the study.

ChapterII concepts and Review

The concepts relating to the problem statement, economics of production, risk and models concerned with risk programming are represented.

ChapterIII Design of the Study

The sampling procedure followed in the study, the mode of data collection and formulation of MOTAD programming model is dealt in this chapter.

ChapterIV Description of the area studied

This chapter presents a descriptive account of the blocks, district studied with particular reference to agroclimatic conditions, land use, cropping pattern and others like infrastructural facility so as to set background

for the analysis and keep the situation relevant to the study.

ChapterV Results and Discussion

Organised as per the objective, first it deals with production function analysis followed by risk programming.

ChapterVI Summary and Conclusion

A summary of the results is presented and inferences are drawn including their implications.

Concepts and Review

CHAPTER II
CONCEPTS AND REVIEW

Understanding the nature of risk aversion behaviour and formulating farm plans are the major concern of this study. This chapter deals with the review of concepts related to the objective of study. For convenience it has been separated into two sections. Section I focuses on economics of rice production and section II is devoted to the meaning and definition of risk, measurement of risk and decision making models. In this section also some past studies are briefly reviewed.

SECTION - I ECONOMICS OF RICE PRODUCTION:

For better exposition the review is classified under the following sub headings;

1. Productivity
2. Cropping pattern
3. Studies on costs and Returns
4. Production function analysis

Singh defined agriculture production as the yield per hectare of land.¹

¹Jwala Prasad Singh " Productivity of Crops in Indian Agriculture," **Productivity**, 88(2): 169-186, 1984.

Pandya considered productivity in terms of output per unit of input. In other words it is output per every Kilogram of seeds sown, every litre of irrigation water used, for every Kilogram of fertilizer applied and per every unit of energy employed in the farm operation.²

Sankaran and Parihar decomposed the growth per hectare value (productivity) and aggregate value (production) into individual effect of area, cropping pattern, yield and relative prices and that of their interaction.³

Rana forcefully argued that the only significant factor highlighted for land productivity are irrigation and fertilizer use. He suggested that the policy measure of future should aim at higher allocation of funds towards irrigation, in those states where production is low.⁴

²A.C.Pandya "Input of farm mechanisation on Agricultural Productivity" **Productivity** 18(2): 245-248, 1980.

³P.L.Shankaran and R.S.Parihar. "Comparison of Growth of Agriculture Productivity and Production in Punjab during 1966-1971 to 1981-86", **Economic Affairs**, 33(3): 165-172, 1988

⁴R.K.Rana "Land productivity differentials in India: An empirical study", **Indian Journal of Agricultural Economics** 45(1): 51-52, 1990.

Attibudhi et al highlighted some of the constraints which inhibited growth in productivity of farms. They were i). use of ground water for irrigation, though lift posed problems due to low water table; ii) unsuitability of crop variety like groundnut and mustard to the particular soil type put another hurdle in the way of realising higher productivity.⁵

CROPPING PATTERN

Effective utilization of scarce resources is a crucial determinant of Agriculture production and growth. But this utilisation pattern differs from farm to farm; depending on the types of crops choosen for cultivation. So it necessiates to study on the cropping pattern followed in the area.

Khirsagar identified several key determinants of cropping pattern. The physical and climatic determinants are rainfall, irrigation, soil types and size of plot. The socio-economic determinants comprised of income, prices, risks, farmers resource base, age and education.⁶

⁵H.N.Attibudhi, M.L.Chakraverty and J.P.Singh "An economic analysis of rice based cropping system in Orissa," **Agriculture situation in India**, 17(12): 840-842, 1993.

Attibudhi *et al* defined cropping pattern as a sequence of crops grown on a specific piece of cultivated land over a period of time and seeks to increase the benefit through use of available physical resource with the farm household.⁷

In the present study cropping pattern is defined as sequence of crops grown in a given piece of land in a year.

STUDIES ON COSTS AND RETURNS

The profitability of any farm business can be deduced from the relationship between costs incurred in running the business and the returns received from the operation. Costs are classified into fixed costs and variable costs.

Tandon and Dhondyal defined variable costs as the prime costs and these costs are related to the variable resources and change with the level of output.⁸

⁶K.G.Khirsagar "Dynamics of cropping pattern in the semi arid tropics of India, (unpublished) Ph.D thesis, UAS Bangalore, 1990.

⁷H.N.Attibudhi, M.L.Chakraverty, J.P.Singh, *Opp cit*, pp 840-842.

⁸R.K.Tandon and S.P.Dhondyal, Principles and methods of farm management (Kanpur: Nirbal-ke-Balram Press, 1971) P-15.

Bernard and Nix classified costs into variable and fixed, cost. Fixed costs represented overhead farming expenses, it did not change with the level of output. Taxes, depreciation of assets, cess, interest payment and rent formed the fixed costs. Whereas variable cost would change with the level of output.⁹

Rao considered four cost concepts. He considered cost A_1 as the expenditure incurred by farmer in cash and kind, cost A_2 as cost A_1 plus rent paid for leased in land, cost B as cost A_2 plus rental value of owned land and interest on owned fixed capital (excluding land) and cost C as imputed value of family labour added to cost B.¹⁰

Sharma and Sharma defined variable cost as farm expenses that varied with output and they did not occur if nothing was produced.¹¹

⁹C.S.Bernard and J.S.Nix, Farm planning and control (Cambridge: Cambridge University Press, 1973), P-45.

¹⁰S.Sangeetha Rao, "Trends in the behaviour of cost of production of paddy in Andrapradesh during 1971-72 to 1975-76" **Agriculture situation in India** 35(2): 75, 1980.

¹¹A.N.Sharma and V.K.Sharma, Elements of farm management (New Delhi: Pentice Hall of India, Pvt. Ltd. 1981) P:19.

According to Sharma, the cost of production comprised of fixed cost and variable cost. Fixed cost included expenses made on permanent human and animal labour, depreciation on farm implements and machineries, land revenue and cesses, rental value of land and interest on permanent investments other than land. The variable cost covered wages paid to hired human labour, cost of seed, manure and fertilizers, irrigation charges, betterment levy and miscellaenous costs such as plant protection charges cost of gunny bags and interest on variable costs.¹²

Application of farm inputs involved costs which were divided into fixed and variable costs. Fixed costs referred to the costs which do not vary with the output in the short run. They were also called as overhead cost and committed for rental, maintenance, depreciation, overheads salaries and wages.¹³

According to Kahlon and Sandhu fixed cost included the depreciation on the value of capital investment. An

¹²A.C.Sharma, "Scale Economics in the production of Farm groups in the cotton Belt of Punjab," **Indian Journal of Agricultural Economics**, 49(3): 283, 1969.

¹³Paul samuelson, Economics (Tokyo: McGraw-Hill Kogakusha Limited, 1973), p 465.

additional item of rent paid or payable is also taken into account.¹⁴

Mittal and Saxena defined fixed cost in agriculture as that which is independent of the level of production whereas the variable costs varied with the level of output.¹⁵

Seth defined fixed costs as those cost which do not vary with the change in farmers output over the short run. They were incurred even if there was no production. Rent, property taxes, interest charges and salaries were expenses of fixed costs. Variable cost changed with the level of output and it increased with the increase in output.¹⁶

Bal defined the total cost into six different groups viz., cost A₁, Cost A₂, Cost B₁, Cost B₂, Cost C₁ and Cost C₂. Cost A₁ included all cash and kind expenses actually incurred while

¹⁴S.S.Kahlon and H.S.Sandhu, "Economic Evaluation of Dry Farming in Punjab", **Indian Journal of Agricultural Economics**, 26(4): pp 342,1971.

¹⁵J.P.Mittal and P.P.Saxena, "A Mathematical Expression for Cost and Analysis of Farm Equipments" **Indian Journal of Agricultural Economics**, 29(1): p51, 1974.

¹⁶M.L.Sheth, **Principles of Economics**. (Agra: Join sons Printers, 1985) p.213.

- Cost A₂ = Cost A₁ + rent paid for leased in land
- Cost B₁ = Cost A₁ + Value of owned capital assets
(excluding land) + interest on fixed
capital and live stock
- Cost B₂ = Cost B₁ + Rental value of owned land
(net of land revenue) + rent paid for
leased in land
- Cost C₁ = Cost B₁ + imputed value of owned family
labour used in farming during the year.
- Cost C₂ = Cost B₂ + imputed value of owned family
labour used in farming during the
year.¹⁷

Garg and Singh found out the per hectare cost of all inputs used on irrigated as well as dry farms. They concluded that per hectare cost of inputs of irrigated farms were about 2.5 times more than that of dry farms. The calculated 't' value for per hectare costs of inputs between dry and irrigated farm came to 14.28 which was significant at 5% level.¹⁸

¹⁷H.S.Bal, K.K.Jain and Beant Singh "An Economic analysis of Farm business in Punjab" **Agriculture situation in India**, 46(4): 191-200, 1991.

¹⁸J.S.Garg and G.N.Singh, "Income disparity between Dryland and Irrigated farms in District Kanpur, Uttarpradesh",

Viswanath observed that the cost of human labour, bullock labour and the total cost of cultivation per acre decreased as the size of holding increased for dry as well as irrigated paddy, wheat, barley and sugarcane. In each size group the cost of each input (except seeds) and total cost per acre for the cultivation of non-irrigated crops is lower than that of irrigated crops. The cost of seed remained almost same for each size group. Per acre cost of manure and fertilizer however showed no relationship with size of the farm.¹⁹

In the present study the concept of variable cost and total cost were used. Variable cost included all the cash and kind expenses actually incurred on the working capital plus the interest rate. Total cost included all variable cost plus the fixed cost namely the rental value of land, interest on fixed capital, land revenue, water cess and other taxes and the depreciation on fixed capital. Detailed description of cost A₁, A₂, B₁, B₂ etc are given in Design of the study chapter.

Indian Journal of Agricultural Economics, 23(3): 273, 1971.

¹⁹Viswanath "Impact of Technological changes on farm employment and income distribution in Agriculture". (unpublished) Ph.D thesis, Indian Agricultural Research Institute, 1969.

Agarwal **et al** worked out the depreciation on farm assets like building at the rate of five per cent and depreciation of farm equipments at the rate of 15 per cent per annum on calculating the expenditure components involved in production of poultry.²⁰

Mohanty defined depreciation as the salary received by farm equipments for the productive use of the equipments.²¹

Returns

Kohlon **et al** estimated the farm family gross income by adding income from farm and non farm sources and also borrowings from institutional and non - institutional sources.²²

²⁰C.K.Agarwal, S.C. Gupta, R.A.Singh and R.N.Pal "Components of Expenditure and total cost involved in producing Duck and Chicken for Meat", **The Indian veterinary Journal**, 58(3): 219-223, 1981.

²¹P.K.Mohanty "Economics of Betel vine cultivation in Balasore District of Orissa" (Unpublished) M.Phil Thesis, Sambalpur University, 1993.

²²A.S.Kahlon, H.S.Bal and Gurubachan Singh " Saving and investment pattern of farm families in Punjab" **Indian Journal of Agricultural Economics** 27(4): 36, 1972.

Khare included income from subsidiary occupation in farm income. Subsidiary income included wages, salaries and redefined income as receipts net of operating expenses.²³

Shukla and Mishra defined net income as gross income minus total cost. Farm business income equalled gross income minus cost A_1 in owner operated forms and gross income minus cost A_2 in tenant operated farms.²⁴

Bal defined farm income as cash receipts plus value of farm produce consumed in the farm household minus operating expenses minus depreciation on sunk capital change in the farm inventory.²⁵

Naidu and Gupta estimated that the net income, family labour income, farm investment income and farm business income to find out the profitability of farm business.²⁶

²³M.P.Khare " Study of income, savings and Investment patterns of farm families in agriculturally progressive areas of Ahmed Nagar" *Arthavigyan*, 1593, 231-281, 1973.

²⁴B.D.Shukla and S.D.Mishra, "Impact of co-operative finances", *Financing Agriculture* 1(3): 26, 1974.

²⁵H.S.Bal "Factor share in farm income and inequality in Punjab", *Agriculture Situtation in India* 37(7): 439, 1982.

Johl and Kapur defined gross return as the total production times the price. Return to fixed farm resource equaled to gross return minus variable costs. These were also known as return over variable costs. Net return was equal to gross return minus all costs.²⁷

Driver and Desai defined farm business income as the real measure of earnings of the farmer and his family for management, risk, labour and use of land and capital. It is obtained by deducting cost A_2 from the value of inputs.²⁸

Kandaswamy, Ramaswamy and Sivanandam used the term gross return to mean the value of the total produce. Net return was the remainder after subtracking total expenditure from gross income.²⁹

²⁶M.K.Naidu and S.B.L.Gupta "A study of costs and returns on the sample farms of East Godavari", **Agriculture situation in India** 37(10): 643, 1983.

²⁷S.S.Johl and T.R.Kapur, **Fundamental of farm business management**, (New Delhi: Kalyani Publishers, 1989) p 59.

²⁸P.N.Driver and D.K.Desai, "Some Input-output relationship in Indian Agriculture" **Indian Journal of Agricultural Economics**, 13(1): pp 50-57, 1958.

²⁹A.Kandaswamy, C.Ramasamy and R.Sivanandam "Economics of Forest Plantations (2) Eucalyptus and Casuariva", **Kisan world**, 7(4): April 1980, pp 33-36.

Chauhan et al referred gross farm income as the value at prevailing prices of retained as well as marketed crop output and also the income from allied activities such as dairy, goats and poultry.³⁰

Karnam Lokanathan defined gross income as total value of output of arecanut, income obtained from sale of leaf sheath and husk retained for farm requirements. The net income was defined as gross income minus total cost comprised of direct and indirect cost.³¹

Singh defined the gross income as the gross value of output (Main plus by products) of crops evaluated at harvest price in the reference year irrespective of being consumed, sold or maintained in the stock less the value of seed.³²

³⁰K.K.S.Chanhan, S.Mundle and D.Jadhan, "Income savings and Investment Behaviour of small Forms", **Indian Journal of Agriculture Economics**, 28(4): pp43-50, 1972.

³¹Karnam Lokanathan, "An Economic analysis of Arecanut Plantations in Coimbatore District", (unpublished) M.Sc (Ag) Dissertation submitted to Tamil Nadu Agricultural University, Coimbatore, 1982, p14.

³²J.P.Singh, "Resource use, Farm size and Returns to scale in a Backward Agriculture". **Indian Journal of Agricultural Economics** 15(3): pp47-55, 1960.

Shanmugham defined gross income as the total value of output of paddy and paddy straw. Net income or the profit was calculated by deducting the total cost of cultivation from gross return in his study of paddy growing farmers of Periyar project area.³³

Sisodia measured the profit by deducting cost from gross income.³⁴

Umasankar and Jha defined net income of the farm as the gross income less variable cost of farm business as a whole.³⁵

Singh et al in their study concluded that the profit per hectare on irrigated farms was higher than that on dry farms. The output input ratio was also higher on irrigated farms with an average of 2.21 as against 1.98 of dry farm.³⁶

³³S.P.Shanmugham, "Pattern of Employment and Productivity in paddy farms of Periyar Project Area", (unpublished) M.Sc (Ag) thesis, TNAU, Coimbatore P.34, 1981.

³⁴J.S.Sisodia, "An Economic Analysis of Farm Development Programme," **Indian Journal of Agricultural Economics** 33(1): pp 93-99, 1978.

³⁵V.Singh and D.Jha, "A note of Efficiency in Transitional Agriculture. A study of Farm in Rural Delhi", **Indian Journal of Agricultural Economics** 28(3): p-61, 1973.

In the present study, gross returns were calculated by taking the value of the produce marketed. Net returns were arrived at by deducting the variable cost from the gross returns.³⁷

PRODUCTION FUNCTION ANALYSIS

The efficiency of production on the farm as a whole is studied by fitting an appropriate econometric model, which necessarily relates the input quantity and output produced.

According to Koutsyianis the production function included all the technical efficiencies of production.³⁸

Misra used the production function to determine the effect of irrigation on production and resource use in Mayurkashi canal irrigated area of Birbhum district of West Bengal. He concluded that co-efficient of regression for

³⁶R.I.Singh, M.S.Bhatia and M.P.Azad "Benefit cost ratio and productivity on dry and irrigated farms in District Unnao (A case study)". **Indian Journal of Agricultural Economics**, 21(2): pp 19-24, 1971.

³⁷R.Singh and R.K.Patel "Farm size, productivity and some related aspects" **Eastern Economist**, 64(2): pp 59-62, 1972.

³⁸A.Koutsoyiannis "Modern Microeconomics" (Hong Kong: The McMillan company Ltd, 1983), p 17.

irrigation showed a significant 't' value with a positive apriori sign, thus acting as significant component of yield increase. He also found resource use like fertilizer and pesticides were positively corelated to irrigation.³⁹

Rane fitted linear and non linear forms of production function for estimating their parameters. For analysis the variation in land productivity, double log linear form was used. The independent factors were per capita cropped area, rainfall index, irrigation index, soil quality index and fertilizer use index. He obtained a higher R^2 value of .89 suggesting a good fit, for him cropped area index and irrigation index came significant in coherence to apriori expectation.⁴⁰

Duar et al regressed yield over water quantity and quality, soil salinity and drainage volume. The interesting fact came out was the significance of salinity showing that

³⁹Ranjan Mishra "Input of irrigation in Production and Factor use. A case study of Mayurkashi canal in West Bengal", **Indian Journal of Agricultural Economics** 39(3): p: 548, 1984.

⁴⁰R.K.Rane, "Land productivity differentials in India: An empirical study", **Indian Journal of Agricultural Economics**, 45(1): p 51, 1990.

farmers were not aware of salinity treatment which was the cause of yield loss.⁴¹

Chopra defined production function as a statement of technical facts which the producer uses to obtain the least cost combination of inputs to produce an output.⁴²

Rajendran in his study selected a linear production function based on the scatter diagram between the total output of chillies and the input factors like bullock labour, human labour, seeds, manures and fertilizers, plant protection, irrigation, land value and area under chillies.⁴³

Mishra and Gupta used quadratic function to study the response of Kalyan 227 wheat to fertilizer application,

⁴¹A. Duar, J.D.Rhodes, P.Nash & B.C.Waggner "Production function relating crop yield, water quality and quantity, soil salinity and drainage volume" **Agriculture water management**, 19: pp 51-66, 1992.

⁴²P.N.Chopra, **Advanced Economic Theory** (New Delhi: Kalyani Publishers, 1978), Section C, P.11.

⁴³G.Rajendran, "A study on the Economics of production and Resource use Efficiency in Chillies Farms of Sattur Taluk, Ramanathapuram District", (unpublished) M.Sc (Ag) Thesis, TNAU, Coimbatore, 1978, p-29.

which proved to be significant. Then they found out the optimum fertilizer uses for Kalyan 227.⁴⁴

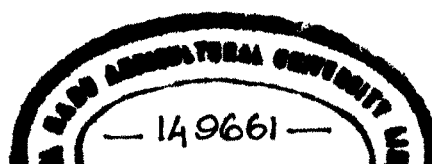
✓ Ramamurthy **et al.** studied the effect of farm size on resource productivity. The Cobb-Douglas production function was used, to analyse the data. They found that all the variables viz. labour, manures and fertilizers, seeds, plant protection and management, significantly influenced gross income in all the size groups of farms.⁴⁵

Chawdhury **et al.** viewed that MVP of land, human labour, bullock labour and working capital were by and large higher on the package farms than non package farms of Orissa whereas that of bullock labour it was negative in Andhra Pradesh. The MVP of fixed capital for package farms of Punjab and Orissa was negative.⁴⁶

⁴⁴V.N.Mishra and S.B.L. Gupta, "Fertilizer Input on Resource Productivity", **Indian Journal of Agricultural Economics**, 52(4): P 302, 1971.

✓⁴⁵K.Ramamurthy; M.Ramachandran and S.R.Subramaniam, "The influence of Farm size on Resource Productivity". **Madras Agricultural Journal** 9(1): pp 49-55, 1973.

⁴⁶T.P.Chawdhary, S.P.Tripathy, "Resource use and Productivity" **Indian Journal of Agricultural Economics**, 25(11), pp 168-169, 1970.



Radhakrishna found that the marginal value product of land had a positive relationship with irrigation. The marginal value product of land for irrigated and non irrigated regions were Rs.108.90 and Rs.86.49 respectively. But the marginal value product for human labour and pair-day of bullock labour in irrigated region were less than those in dry region.⁴⁷

Sisodia and Agarkar used Cobb-Douglas production function and defined returns to scale as the sum of all the exponential regression co-efficients. The sum of elasticities (Regression coefficients) was 1.864 for dry farms, while the corresponding figure for partially irrigated farm was 1.968.⁴⁸

In the present study Cobb-Douglas production function was used, as the scatter diagram showed it to be the best fit.

⁴⁷D.Radhakrishna " A study on productivities of Agricultural Inputs" **Indian Journal of Agricultural Economics**, 26(2): pp 39, 1964.

⁴⁸J.S.Sisodia and V.L.Agarkar "Nature of Instability and Resource productivity in Dry land Farming" **Indian Journal of Agricultural Economics**, 31(2), pp: 29-32, 1971.

SECTION II RISK AND UNCERTAINTY

Knight the Pioneer among risk studies defined risk with the help of mathematical concept called probability distribution of outcome of any event. He distinguished risk from uncertainty based on the fact that if the probability distribution of outcome of any event was known it was risk but if it was unknown it was called uncertainty.⁴⁹

Heady furthered Knight's concept by defining risk as the variability of the outcome and it could be measured quantitatively.⁵⁰

However later a few economists did not agree on the distinctions between risk and uncertainty and used the term interchangeably.

⁴⁹Frank .H Knight "Risk uncertainty and Profit (Boston: Houghton Mufflin Company, 1957) p 47.

⁵⁰Earl. O. Heady "Economics of Agricultural Production and Resource use" (New Delhi: Pentice Hall of India Pvt. Ltd.) 1964 pp: 439-444.

Sharpe argued that a distinction between risk and uncertainty was practically meaning less. Few other workers also supported his argument.⁵¹

Classification of Risk in Agriculture

Dillon defined risk in agriculture as the expected value of loss, the probability of loss, the probability of ruin or a simply random variable. He drew a comparison between two risky prospects citing that though riskier prospect would have some outcome, its cumulative distribution did exceed that of less risk prospect.⁵²

Ray in his book classified risk as property and personal risk, which also included natural risk from rainfall, social risk and economic risk like heavy loss.⁵³

Vyas & Rarkhal considered risk in obtaining yield and price uncertainty as relevant to crop planning. Yield risk arose due to rainfall, factor cost and lack of input use

⁵¹W.F.Sharpe " A simplified model for Portfolio Analysis" **Management Science**, 9(2) pp 277-293, 1963.

⁵²John.L.Dillon "An expository Review of Burnollian Decision theory in Agriculture: Is utility Futility", **Review of Marketing and Agricultural Economics** 33(1), 29,1971.

⁵³P.K.Ray "Principles and practices of Agriculture Insurance" (Calcutta: Book Land Pvt. Ltd, 1958) P.22.

whereas price uncertainty was due to sudden supply and lack of perfectly tailored policy.⁵⁴

Sen viewed that risk in Indian agriculture was mainly stemming from uneven distribution of rainfall, diseases and pest attack, unstable prices, unfavourable parity prices, inadequate storage conditions and finally insufficient transport facilities.⁵⁵

Maleka in his study in Gwemby valley of Zambia defined agriculture to be risky as it was carried out under stochastic nature of rainfall. Stochastic referred to some random character over which human lacked control.⁵⁶

Aggarwal in his study classified risk under five heads
i) variation in production due to natural hazards (ii) Price changes (iii) technological changes (iv) actions of the people, organisation with whom the farmer does business with

⁵⁴V.S.Vyas and K.R.Rarkhal "Uncertainty in crop planning" **Indian Journal of Agricultural Economics** 19(1) 101-106, 1969.

⁵⁵S.N.Sen "Nature and Role of Risk and Uncertainty in Agricultural Production in Bihar." **Indian Journal of Agricultural Economics** 19(1): 107-109, 1969.

⁵⁶Phiri Maleka, "An application of Target MOTAD model to crop production in Zambia: Gwembe valley as case study" **Agriculture Economics** 9, pp15-35, 1993.

and (v)) unfavourable outcomes affecting the health and ability of the farm operator are his family members. Thus, several studies gave different versions of classification of risk in agriculture.⁵⁷

In this study risk was considered to be economic risk or deviation in expected farm income, from the mean income.

Risk Measurement

The classification of risk programming models is based on the modelling approaches that treat risk in the various co-efficients such as c_j , a_{ij} and s_j values. But this classification is not exhaustive. However risk programming models are studied under the following heads:

1. E,V analysis
2. Game Theory model
3. Safety first models
4. Stochastic programming models
5. Chance constrained programming models
6. Generalised goal programming models.

⁵⁷B.L.Aggarwal, "Risk and uncertainty in Agriculture, Implications Agricultural Credit", **Indian Journal of Agricultural Economics** 53(4) 222-227, 1971.

E.V. Analysis

Markowitz was a pioneer in the portfolio selection model or E.V. analysis model because he introduced the concept of portfolio into the field of investment decision. His problem was to select a portfolio of risky stocks under a budget constraint. He used quadratic programming algorithm to solve the problems.⁵⁸

Chen and Baker developed marginal risk constrained linear programming as an alternative to LP and QP. Their model simply maximised the expected income subject to usual constraints to which a set of marginal risk constraints were added.⁵⁹

Freund introduced risk component in the programming model and compared the solutions with Markowitz's LP model. He found that his optimal plan was quite different from Markowitz's optimum form plan. Hence Freund concluded that neglect of risk could give irrational plans.⁶⁰

⁵⁸H.M. Markowitz, "Portfolio selection", **Journal of Finance**, 7(3) 82-92, 1952.

⁵⁹T.J. Chen and C.B. Baker, "Marginal Risk constrained Linear Programming for Activity Analysis", **American Journal of Agricultural Economics**, 56(3): 622-627, 1974.

Scott and Baker calculated efficient E, V path and the lower income bounds associated with it. They found efficient E, V by parametrising the risk aversion Co-efficient and the results were shown graphically. This process allowed the farmer to make a choice of enterprise combinations.⁶¹

Rajagopalan and Vardarajan studied the risk associated with farms. They developed the farm plans with the help of QRP separately for traditional and modern farms. Modern farm were found to be with higher income but also with higher risk. They suggested crop insurance, stable credit policy etc. as measures for risk management.⁶²

Singh and Ziberman studied the allocation of land and nitrogen for crops under irrigated and unirrigated condition in two separate seasons of Kharif and Rabi. They found that existing crop plan to be different from efficient E, V farm

⁶⁰R.J.Freund, "The introduction of Risk into Programming model", **Econometrica** 24(2): 253-263, 1956. +

⁶¹John T. Scott and Chester B.Baker, "A Practical way to select an optimum Farm plan under Risk." **Americal Journal of Agricultural Economics**, 54(4,I): 657-660, 1972. +

⁶²V.Rajagopalan and S.Varadarajan, "Impact of Risk and uncertainty on Farm Production and Income in the Hill's of Nilgiris, Tamil Nadu, **Indian Journal of Agricultural Economics**, 33(4): 35-42, 1978. +

plan. They attributed this difference as the inefficient farming due to failure in taking into consideration risk arising due to price instability.⁶³

Hazell developed MOTAD model. It uses a linear decision criterion with expected return and minimum absolute income deviation. Risk was introduced as the mean absolute deviation of income (A) and Hazell tried to minimise 'A' in income for a given level of expected net income (E). This model can also be called as E,A analysis are MOTAD. It replaced QP. It helped to reduce the bulk work of collecting time series data for QP.⁶⁴

Maximising the profits of farm is done through the optimisation of resource use. Few attempts done in past to optimise resource use is used here,

Viswanathan used linear programming by developing a synthetic farm situation and studied the scope of

⁶³C.Singh and D.Zinbernnan, "Allocation of Fertilizer Among crops under Risk. A Quadratic Programming Approach" **Indian Journal of Agricultural Economics** 39(1): 77-84, 1984.

⁶⁴P.B.R. Hazell, "Game Theory An Extension of its Application to Farm Planning under uncertainty". **Journal of Agricultural Economics**, 21(2): 239-259, 1970.

optimisation of crop mix. He could conclude that a mere re-allocation of the existing resource helped to boost up farm income.⁶⁵

Krishnamoorthy and Randhir used MOTAD a modification of LP to find out optimum crop combination parametrised over water supply. They parameterised the expected farm income over set of water supplies and found out set of E-V efficient farm plans. They argued that as the efficient farms had more returns it was open for farmers to choose the optimum plan.⁶⁶

Kahlon told optimisation meant optimum allocation of resource among various enterprises, so it necessarily involved farmer's individual decision making.⁶⁷

⁶⁵R.Viswanathan "An economic analysis of multiple cropping in wet land of Mannargudi Block of Thanjavur district", (unpublished) M.Sc (Ag) Thesis, University of Madras, 1970.

⁶⁶S.Krishnamoorthy, Timothy Randhir "Optimal crop planning under production Risk in Tankfed South Indian Farms". **Indian Journal of Agriculture Economics**, 48(4): pp 678-686.

⁶⁷A.S.Kahlon "Technical Bulletin on Agriculture" (New Delhi Indian Council of Agricultural Research, 1992) pp 1-3.

Sipra in her study in Punjab used Quadratic programming model and parametrised returns of crops within the reasonable limits. She assumed yield variation was due to stochastic rainfall. Efficient crop combinations, corresponding expected income and standard deviation (E,D) were compared with actual situation. She found that optimal plans were consistent with existing plans suggesting the knowledge of farmers.⁶⁸

Mrityunjaya use MOTAD model to evolve farm plans. He included dairy units and found it as a stability towards expected returns. As farm operations got diversified, risk or the loss in expected income got reduced.⁶⁹

Maleka used TARGET MOTAD model to study the farmers decision making behaviour in Gwembe valley of Zambia whereas MOTAD model measured risk in terms of absolute deviation of income from mean income, the target motad model measured risk in terms of absolute deviation from prespecified income. He found out that when cost of credit, and cost of risk taking were very high, farmers preferred

⁶⁸Sipra Dasgupta, "Agriculture: Producers" Rationality and Technical change : (Asia publishing house 1970)

⁶⁹Mrityunjaya "An Economic Analysis of Risk in Drought Prone farms in Bijapur district, Karnataka. (Unpublished) Ph.D thesis, IARI, New Delhi, 1976.

varieties resistant to stochastic nature of rainfall, i.e., the drought resistant varieties.⁷⁰

In the MOTAD model risk is measured as a linear deviation from the mean. As risk is undesirable, it is minimised. Target motad model was more specific than the generalised MOTAD.

Though literatures are available on other model of studies of risk modelling, they are not useful for the present study.

The foregoing discussions suggests how important it is to incorporate risk to evolve optimum form plan. However not a single method is appropriate. All the methods have their own positive and negative points, so under this situation it is important to formulate a situation specific model.

⁷⁰Phiri Maleka opp cit. 15-35.

Design of the Study

CHAPTER III

DESIGN OF THE STUDY

In this chapter, the sampling design, conduct of the field survey and tools of analysis used for this study are discussed in brief.

Selection of the study area:

Since the prime objective of the study is to determine the risk associated with rice production, Cuttack district was chosen as the universe of the study as it ranks first in the acreage devoted to rice. In this district based on the acreage of rice and irrigation potential Barchana block was selected as the study area. Then 5 villages were selected from the block by simple random sampling method. Total 90 samples were collected, distributed equally among all the villages, for the present study. Then the collected samples were post-stratified into three size groups of small (0 to 1.0 ha.), medium (1 to 2ha.) and large (2.00 and above).

Collection of data

The selected farmers were contacted in person and required data were collected by interview method with the help of a pretested schedule. The farmers were asked about demography, land holding, cropping pattern and cost of cultivation of rice. The data were collected in the month of

December 1995 and January 1997 and they were related to the crop year 1995-96.

Tools of analysis

Estimation of Fixed capital (Assets)

In estimation of fixed capital, six major assets namely farm land, farm buildings (such as cattle sheds, storage room, godown, pumphouse, livestock, farm implements and machineries, non agricultural assets and financial assets were considered under the fixed assets in the study. The landed property was evaluated at market price, which otherwise meant the price that the farmer could pay for similar land was its value. The farm buildings were also evaluated its market price at the time of enquiry. For assessing the cost of livestock similiar procedure was followed. For farm implements and machineries they were evaluated as cost minus depriciation charges. The depriciation was calculated by straight line method, which assumed equal depriciation over all the years. In a similiar way valuation of non agricultural assets were also made. Financial assets included postal savings, life insurance, premium paid and loans due from others. On the basis of these estimations per farm and per hectare value of farm assets were worked out for different categories of sample farms .

Estimation of capital Expenditure

Capital expenditure in the study referred to the actual amount spent towards the acquisition of capital assets during the year. The main items of capital expenditure were; i) land improvement ii) livestock improvement iii) agricultural implements and machineries iv) non-agricultural assets. The sub items under land improvement included a) building b) levelling c) fencing and d) wells dug and other expenditures. The item livestock had sub items of i) draught cattle ii) draught and milch cattle and iii) cross bred cattle. The item agricultural machineries included i) low valued plough and other related minor implements ii) purchase of bullock carts iii) purchase of sprayers and purchase and maintenance of all other assets which were not used for agricultural purpose were included under the term non agriculture assets.

In this way the Per farm and per hectare capital expenditure were worked out for different size groups of farms.

Estimation of working capital (Current Farm Expenditure)

Generally the current farm expenditures are divided into two groups.

- i) non-cash expenditure and
- ii) cash expenditure

The non-cash component included family labour value of owned bullock power and home grown seeds and manures produced on farm etc. The cash component included the amount of money spent on hired human labour, bullock power, seeds, manures and fertilizers, insecticides, pesticides, irrigation, livestock maintenance and hiring of implements and machineries. The individual component under cash and non-cash expenditure were calculated at the prevailing market price. Actual amount paid in cash or kind to the permanent and hired labour and imputed value of family labour was considered as expenses on human labour. The bullock power charges in general was accounted for by the market price availing at that area while, for the purchased seeds actual purchase cost of the seed were taken into account. Similarly the home produced manures were valued at the prevailing market price and its value was taken into account. Actual expenses made for purchase of fertilizers, plant-protection materials, irrigation, maintenance of farm equipments and livestock etc. were considered, while computing the current farm expenditure. The current farm expenditure were calculated separately for the different categories for the year 1995-96.

Estimation of Gross farm outputs

Gross farm output included the receipt from all sources i.e., Sale of livestock, livestock products, value of crop

production, and production consumed by the farm family. The gross farm output was estimated by multiplying the output of different crops by their respective market prices, and then by adding these, gross farm output was arrived at in respect of each farm size group.

Cost Concepts

For assessing the costs and returns of rice four cost concepts were used viz., Cost A₁, Cost A₂, Cost B and Cost C.

Cost A ₁	=	Cost of hired human labour + Value of hired bullock labour + Value of owned bullock labour + hired machine charges + Value of owned machine charges + Value of pesticides and insecticides + Value of manures and fertilizers + depreciation on implements, building, repair of implements and machineries buildings. + irrigation charges + land revenue, cesses + interest on working capital
Cost A ₂	=	Cost A ₁ + rent paid for leased in land
Cost B	=	Cost A ₂ + imputed rental value of owned land, cess, land reveue paid there.
Cost C	=	Cost B + imputed value of family labour

3.6 Returns

Gross Income	=	Value of total output (Main + bi-product)
Farm business	=	Gross income - Cost A ₁ (but cost A ₂ in case of leased in land)
Family labour income	=	Gross income - Cost B
Farm investment income	=	Net income + Rental value of owned land + interest on owned fixed capital
Net income	=	Gross income - Cost C

Factor efficiency

The efficiency of individual factors such as human labour, bullock power, seeds, manures; fertilizers and irrigation was worked out by the following formula.

$$\text{ith factor efficiency} = \frac{\text{Gross output}}{\text{(Total cost of input - Cost of inputs other than i)}} \times 100$$

Efficiency of total farms for different sizes was calculated as,

$$\text{Efficiency of the farm} = \frac{\text{Gross output}}{\text{Cost of total input}} \times 100$$

Conventional analysis

Conventional analysis namely the average and percentage analysis was done to study the costs and returns. Percentage

analysis was used to study the factor share in the cost of cultivation.

Production function analysis

The relationship between yield and different inputs used was studied using a functional analysis. After plotting the scatter diagram, and rejecting a few outliers Cobb-Douglas production function was specified for both the blocks.

The usual form of function as follows.

$$Y = a x_1^{b_1} x_2^{b_2} \dots x_n^{b_n} e^u$$

Where, Y = output, and X_1, X_2, \dots, X_n indicate the factor inputs. b_1, b_2, \dots, b_n are the regression co-efficients to be estimated. 'a' is the regression constant or intercept which has its presence due to omitted variables and approximation of functional form, if any. 'U' is the random error term satisfying classical normal assumption.

The log form of the function converts it to a linear function as follows.

$$\log Y = \log a + b_1 \log x_1 + b_2 \log X_2 + \dots + U \log 'e'$$

where for this study.

Y = Gross return in rupees

X₁ = Land in hectares

X₂ = Human labour in mandays

X₃ = bullock labour in pairdays per hectare

X₄ = manures and fertilizer in Rupees/hectare

X₅ = Irrigation charges in Rupees per hectare

X₆ = seed value in rupees per hectare

X₇ = plant protection measure in rupees per hectare.

Production elasticities or regression co-efficients

For testing the regression co-efficients or production elasticities 't' value was calculated using the formula

$$\hat{t}_{cal} = \frac{\hat{b}_i}{\text{S.E. of } b_i}$$

Where,

b_i = Regression co-efficient of input X_i

S.E. of b = standard error of b_i

Returns to scale

The sum total of production elasticities of all the inputs ($\sum b_i$) indicated returns to scale

If b_i = 1; constant returns to scale

b_i > 1; increasing returns to scale

b_i < 1; decreasing returns to scale

't' test was used to know whether b_i was significantly deviating from the unity or not.

$$t = \frac{\sum b_i - 1}{\text{SE of } b_i}$$

$$= \frac{\sum b_i - 1}{(C_{11} + C_{22} + \dots + C_{nn} + 2C_{12} + 2C_{23} + \dots + 2C_{mn})}$$

Where C_{11} , C_{22} , C_{23} , C_{33} are the elements of variance, covariance obtained from inverse matrix

Marginal Value product

A resource or input factor is considered to be used most efficiently if its marginal value products is just sufficient to effect its cost therefor a basic condition to be satisfied to obtain efficient resource use.

In Cobb-Douglas production function, marginal value product (MVP) of X_i is given by

$$\text{MVP of } X_i = \frac{\bar{Y}}{\bar{X}_i} \times b_i$$

Where,

\bar{Y} = Geometric mean of output (Y)

\bar{X}_i = Geometric mean of input (X_i)

b_i = regression co-efficient of X_i

After computation of MVP X_i , it was compared with the opportunity cost. It means if the variable in the production

function is taken in rupee terms, its opportunity cost will be one rupee. If the input was expressed in physical unit than opportunity cost is the acquisition cost of one actual physical unit of that input. The significance of differences between marginal value products of resources and their acquisitions costs were tested by tabulated 't' value with the 't' values found out by the formula

$$t = \frac{MVP_i - P_i}{SE \text{ of } MVP_i}$$

$$S.E \text{ of } MVP_i = \frac{\bar{Y}}{\bar{X}_i} \times \text{variance } b_i$$

$$\text{Variance } b_i = C_{ii} \times EMSS$$

where

\bar{Y} = Geometric mean of gross returns

X_i = i_{th} input at geometric mean level

P_i = Opportunity cost of i_{th} inputs

C_{ii} = Diagonal element of i_{th} resource in the inverse, variance - Covariance matrix

EMSS = Error mean sum of squares obtained from ANOVA table.

All statistical tests were carried out for five percent and one per cent level of significance.

Garrett's Ranking Technique

Garret's ranking technique was used to analyse the problems associated to capital constraints and criteria for farmers' preference to choose any particular loanee like non institutional lender or institutional lender. Non institutional lenders constituted village level professional lenders, land lords and family members. Among institutional credit agencies figured financial co-operatives, gramya bank and commercial banks. The farmers were asked to give rank to the respective factors. The order of merit given by the respondents were converted into rank by using the following formula.

$$\text{Percent position} = \frac{100(R_{ij} - 0.50)}{N_j}$$

Where

R_{ij} = rank given for i th factor by j^{th} farmer

N_j = No. of factors ranked by farmer.

The per cent position of each rank thus obtained was converted into scores by referring to the table given by Garrett. Then for each factor the scores of individual farmers were added together and divided by the total number of respondents for whome the scores were added. These mean scores for all the factors were arranged in ascending order, ranks were assigned and important factors were identified.

Risk programming

To study the risk associated with optimum farm plans generally Quadratic risk programming model or MOTAD (Minimisation of Total Absolute Deviation) is followed. But paucity of time series data creates the problem in Quadratic Risk Programming. So Hazell modified the common linear programming model by introducing deviations in expected gross margin as risk rows, and the objective function changed to minimisation.

Here the risk is the mean absolute deviation of the expected form income, given by

$$M = S^{-1} \sum_{i=1}^n \sum_{j=1}^n [(C_{ij} - C_j) X_j]$$

The 'M' includes both positive (Z_t^+) and negative (Z_t^-) deviations, and they cancel out at the mean value (C_j). So alternatively sum of the absolute values is used that is,

$$|Z_t^-| = |Z_t^+|$$

Now it is simple to work with either of the deviations. If one takes the mean absolute values of negative deviation about the mean, it comes as

$$D = \frac{M}{2} = S^{-1} \sum_{i=1}^n \min \sum_{j=1}^n [(C_{ij} - C_j) X_j, 0]$$

Where D = mean absolute values of negative deviation .

Hazell used this concept in his own modified version as,

$$\text{Min } 0.5 \quad W^{1/2} = |Z_t^-|$$

Such that $\sum_j (C_{jt} - C_j) X_j + Z_t^- >, 0$, for every t ;

Subjected to $\sum_j C_j X_j = \lambda$: MAX ----->

$$\sum_j a_{ij} X_j < b_i; \text{ for every } i;$$

Where $X_j, |Z_t^-| > 0$ for every j, t ;

In his model the mean absolute deviation of variance was given by

$$V = F (1/T) \{ (Z^t + Z_t^-) \}^2$$

Where 'F' was a constant that related the sample near absolute deviation to the population variance.

$F = T \cdot \pi / 2(T-1)$ where π was the mathematical constant.

Again he argued that as F/T^2 is a constant for a given farm problem so V can be divided by F/T^2 to obtain W .

$$W = (T^2/F) \cdot V = \left\{ \sum_t (Z_t^+ + Z_t^-) \right\}^2$$

Now Hazell⁷⁰ used the square root of 'W' since the ranking of farm plans by $W^{1/2}$, is the same as the ranking of W.

Thus the risk equation are replaced by sum of error terms alone for each of the risk years. A brief description of variables is presented below.

- 15
- Z_t^- = absolute value of total negative income deviation in year t
 - X_j = level of j^{th} activity
 - C_j = expected net returns of j^{th} activity
 - a_{ij} = technical requirement of j^{th} activity for i^{th} resource
 - b_i = endowment level of i^{th} constraint
 - n = number of activities
 - m = number of resource constraints
 - t = number of years
 - λ = a scalar representing level of expected aggregate net income of the farm to be parametrised from zero to
 - W = $V \cdot (T^2/F)$

⁷¹P.B.R.Hazell *Opp. Cit.*, pp: 53-62.

The assumptions involved in formulating the MOTAD are

- i) normality of population
- ii) uncertainty of future income is adequately represented by the sample data

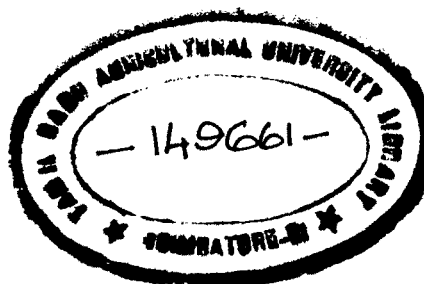
The representative farm was selected so as to satisfy proximity to the Day's criteria of

- i) $A_i = A;$
- ii) $C_i = C;$
- iii) $b_i = \gamma_i b, r_i > 0;$

Where A_i is the technology coefficient, ' C_i ' represents objective functions coefficient and ' b_i ' the resource endowments. The subscript 'i' refers to the representative farm and γ_i is a vector of endowment share. In otherwards the representative form is nothing but selection of one among the sample forms such that it stands closest to the sample means of income, technology levels and resource endowment.

Now the MOTAD was run several times taking different levels of (expected income) so as to draw the E-V frontier. Where E represents the expected income and V stands for variance. The absolute deviations were converted to standard deviation by using the formula

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$$= A(\pi S/2(S-1))^{1/2}$$

Where

- σ = Standard deviation
- A = Mean absolute Deviation
- S = number of risk years taken
- π = a mathematical constant

The E-V frontier was derived by parametrising expected income at 5 different levels.

Estimation of Parameters for the empirical model

Only the crops raised by the farmers in the block were included in the matrix, as a potential activity to serve the objective function. Some of these activities might not be seen in the typical farm, but they were the possible activities and hence constituted the decision variable set. Any subset of this set including the proper set would find place in the optimal solution. It meant that activity to be pursued by the farmer would have positive level while other would be zero. A non negativity condition was implied and explicitly stated. In this study area, though many farmers maintained live stock but it was not a serious activity, hence it was excluded. However in future effort it would be necessary to include them also. So for the block nine crop activities were considered for formulating the initial matrix. The crop activities chosen are presented in Table-1.

**Table:1. Number of Crop Activities Selected for Initial
Matrix Construction of MOTAD.**

Sl.No.	Crop Activities
1	Paddy-1
2	Paddy-2
3	Groundnut-1
4	Groundnut-2
5	Sesamum
6	Sugarcane
7	Bhendi
8	Mustard
9	Blackgram

Input-Coefficients (a_{ij})

By definition, it means the average requirement of i^{th} input per unit of j^{th} crop. It was worked out on the basis of respective units. Land was specified in hectare units, labour was expressed in man hour units, capital was expressed in rupees per hectare and water availability in ha-cm unit.

Constraints

Land availability, labour shortage during the peak seasons of crop activity, ammount of variable cash spent per hectare of the crop activity during one season and water availability for the crop per hectare of land were considered as the four resource constraints for irrigated block. However unirrigated block is devoid of water availability constraint.

Risk rows (d_{ij})

These are the deviations about mean over a five year period for the expected net return measured in Rupees. So mathematically it is

$$d_{ij} = \pm (C_{ij} - \bar{C}_j)$$

Choice of E, V farms

Farmers would choose among a set of efficient E, V farm plans depending on their preferences among various expected income and associated variance levels as described by their E, V utility function. By this procedure a unique farm plan could be identified which would give him highest utility for which variance (V) was minimum.

Where

C_{ij} = Expected gross income in Rs.

a_{ij} = amount j^{th} resource required for j^{th} activity

b_i = endowment level of i^{th} constraint (the RHS) represents the representative form)

d_{ij} = $(C_{ij} - C_j)$ with sign the '+' or '-' deviation of the mean

Z_t^- = Sum of the deviations of C_j for $j = 1, 2, \dots, n$ activities for the year

λ = the scalar representing expected gross income

Alternate plans

Above algebraic model, with specific values for C_j , a_{ij} , b_i and Z_t^- provided the first value. Then the value of λ would be varied. For different assumed values of the problem was solved. Thus for each solution that would be a unique combination of σ and E. When plotted these combinations would yield the E-A curve, any point on it being most efficient and the farmers can choose and most agreeable to them.

A General Format for Initial Matrix of MOTAD programming

Item	X ₁	X ₂	X ₃	Year					RHS
				X _n 1	2	3	4	5	
Obj fn	0	0	0	Z ₁	Z ₂	Z ₃	Z ₄	Z ₅	MIN
Exptd income (Rs.)	C ₁	C ₂	C ₃	0	0	0	0	0	= λ
Land (I) (ha)	a ₁₁	a ₁₂	.	a _{1k} 0	0	0	0	0	< b _{1k}
Land (2) (ha)	a ₂₁	a ₂₂	.	a _{2k} 0	0	0	0	0	< b _{2k}
Labour (1) hrs	.	.	.	.	.	.	.	.	.
Labour (2) hrs	.	.	.	.	.	.	.	.	.
Capital (I)	.	.	.	.	.	.	.	.	.
Capital (II) (Rs)	.	.	.	.	.	.	.	.	.
Water (I) ha cm	W ₁₁	W ₁₂	.	W _{1k} 0	0	0	0	0	< b _k
Water (II) ha cm	.	.	.	W _{2k} 0	0	0	0	0	< b _k
Risk Rows									
1 Year 1	d ₁₁	d ₁₂	.	.	d _{1k}	1	0	0	0 ≤ 0
2 Year 2	.	.	.	.	.	0	1	0	0 ≤ 0
3 Year 3	.	.	.	.	.	0	0	1	0 ≤ 0
4 Year 4	.	.	.	.	.	0	0	0	0 ≤ 0
5 Year 5	d ₅₁	.	.	.	.	d _{5k}	0	0	1 ≤ 0

Description of the Study Area

CHAPTER IV

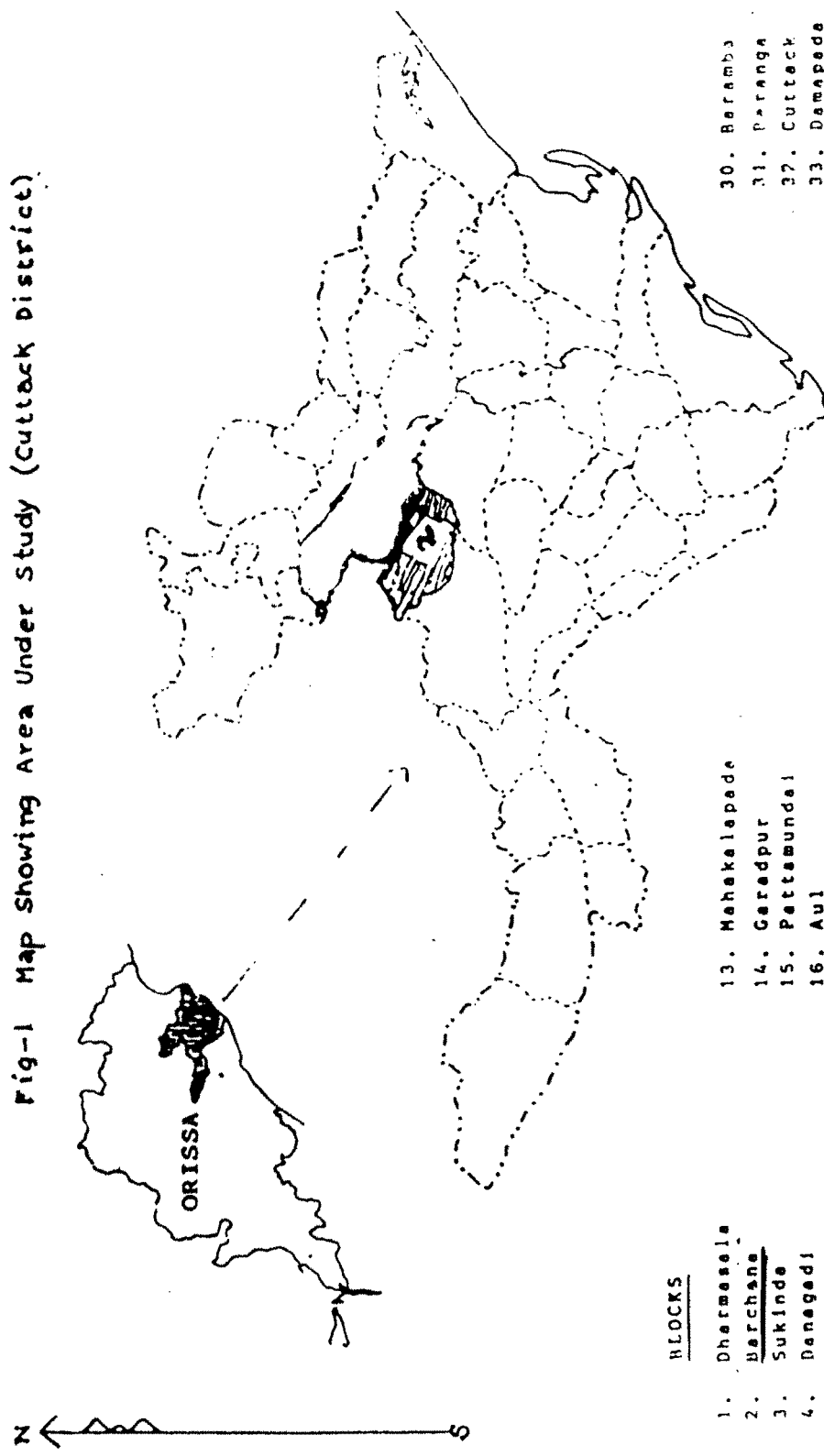
DESCRIPTION OF THE STUDY AREA

To understand the problems and perspective of agriculture in any region information regarding physical, economic and environment conditions is a pre-requisite. Agroclimatic factors like soil, topography, rainfall, irrigation, cropping pattern and economic factors like marketing, infrastructural facilities and important development programmes of the study area are discussed in this chapter.

Geographic Features

Cuttack is one of the coastal districts of Orissa. it is a land locked district with a total geographical area of 11142 square. kms. it is situated at the eastern boundary of the state, with the district headquarteters at Cuttack which is 33 kms distant from state capital. The district lies between $20^{\circ}1'$ N and $21^{\circ}10'$ North latitude and between $84^{\circ}58'$ E and $87^{\circ}3'$ East longitude. Its boundaries in the North extend to Balasore and Keonjhar districts, in the south to Puri district, in the west to Dhenkanal district and in the east to the Bay of Bengal.

Fig-1 Map Showing Area Under Study (Cuttack District)



BLOCKS

- | | | |
|----------------|-------------------|--------------------|
| 1. Dhermesela | 13. Mahakalapada | 30. Baramba |
| 2. Barchana | 14. Garadpur | 31. Paranga |
| 3. Sukinde | 15. Pettamundal | 32. Cutteck |
| 4. Denegedi | 16. Aul | 33. Damapada |
| 5. Korei | 17. Raj Neger | 34. Kantapada |
| 6. Deserathpur | 18. Derehish | 35. Mahengh |
| 7. Binjharpur | 19. Rajkenike | 36. Naisinghpur |
| 8. Jajpur | 20. Biridi | 37. Nieli |
| 9. Rasulpur | 21. Balikuda | 38. Nischintekolli |
| 10. Bari | 22. Tirtol | 39. Sallipur |
| 11. Kendrepere | 23. Reghunathpur | 40. Tenji-Chowder |
| 12. Marahghal | 24. Jagatsinghpur | 41. Tiltira |
| | 25. Ersema | |
| | 26. Gobindpur | |
| | 27. Kujenge | |
| | 28. Athagerh | |
| | 29. Ranki | |

Cuttack district consists of three distinct tracts. The first is marshy strip along the coast covered with low forest and wild growth of canes and brush woods and intercepted by innumerable greens which are sluggish and silty. The second tract is deltaic plains stretching inland for about 64 kms, traversed by many large rivers throughout a network of tributaries.

It is a fertile tract, though affected by frequent floods submerging the standing crops and sand casting arable lands, the third tract is a hilly region at a distance of 112 kms. from the seashore. The district has three main rivers. The Mahanadi, flowing in the south, the Brahmani in the central and the Baitarani in the north.

Climate

The climate of the district is characterised by a hot summer, high humidities nearly all the year round and good seasonal rainfall. The cold season from December to February is followed by the hot season from March to May. the period from June to September constitutes the South-west monsoon season and the next two months are the post monsoon season.

Bay - of - Bengal cross the Orissa coast and more in the Westerny direction causing havoe during these months. The rainfall data for the district is given below in Table -I

Table 3 - Monthwise Rainfall in Cuttck district 84-94.

(in mm)

Month	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94
Jan	10.0	-	-	-	-	11.0	31.0	21.8	-	-	10.0
Feb	9.9	-	-	-	-	-	-	-	-	10.0	8.0
Mar	-	37.8	-	-	-	5.0	-	-	-	-	-
April	-	-	48.0	50.0	-	6.0	27.0	20.0	-	39.6	27.0
May	17.0	32.5	51.0	61.0	13.0	19.5	60.6	65.2	60.5	-	39.5
June	226.2	346.0	359.0	113.0	212.0	168.9	382.6	316.0	200.6	213.0	291.0
July	395.0	521.0	499.0	421.0	475.0	497.0	487.0	392.0	420.0	51.0	528.0
August	354.0	309.0	315.0	208.0	321.5	376.0	452.6	358.0	305.0	331.5	391.5
Sep	198.0	290.5	211.7	125.3	198.0	121.0	319.1	215.2	265.0	228.5	252.0
Oct	68.0	70.0	77.9	62.5	51.0	72.0	92.9	72.5	85.4	72.0	101.6
Nov	13.2	-	-	-	-	-	13.0	5.0	-	8.0	8.0
Dec	11.5	-	5.2	-	-	7.5	-	-	7.5	8.0	-
Total	1302.3	1606.8	1566.1	1040.8	1270.5	1283.9	1865.8	1465.7	1344.1	1421.6	1656.6

Source : Assistant Director of Agriculture, Rainfall Statistics, Cuttack District.

Temperature

The recorded maximum and minimum temperature are 39.5°C to 6.4°C though the minimum temperature near the zone of marshy strip hardly falls below 11- 12°C.

Rainfall

The average annual rainfall of the district is 1501mm, but the actual total rainfall was 1196 mm in the year 1995. Nearly 74 per cent of the total rainfall is received by the district during south-west monsoon months, namely June to September. July is the rainiest month. Most of the storms originating in the Bay of Bengal across the Orissa coast and more in the westerly direction causing havoc during these months. the rainfall data for district is given below in Table:1.

Administrative setup

The district has six subdivisions, 825 gram panchayats and 6602 villages. Total number of co-operatives operating in the district is 1513 catering to the needs of the agriculturist along with 366 commercial and scheduled banks. the total population was 55.03 lakhs as per the 1991 census.

Soil type

The district has mostly two varieties of soils namely alluvial soil in ;the eastern and laterite soil along the

coast. The alluvial soil in the eastern region of the district is very much productive which is suitable for cultivation of rice, sugarcane, pulse and other fruits and vegetables.

Land use pattern

It is important to know the land utilization pattern in a region as it gives picture of land use. This further gives scope to understand the potentialities of the area and nature of the economy, hence the land utilisation patterns is described in Table:2. From the data it was seen that the gross cropped area was 87.34 lakh hectares which constituted 78.39 per cent of geographical area. The district had greater forest cover of 29.82 per cent of total geographical area, net area shown was 49.83 l ha or 44.72 per cent of the total area.

Irrigation sources

Total area irrigated from all sources was 38.42 l ha. During the Kharif season it was 24.63 l ha and during Rabi season it was 13.79 l ha.

The area covered under major and medium irrigation projects in Kharif and Rabi, seasons were 19.75 l ha and 11.05 l ha respectively. The area under minor irrigation

project in Kharif and Rabi seasons were 2.46 l ha and 0.027 l ha respectively.

Table 4. Land Utilisation Pattern In Cuttack District.

Items	Area	%
1. Total geographical area	111.42	100
2. Forest area	33.22	29.82
3. Miscellaneous tree crops & groves not included in net sown area	2.78	2.5
4. Permanent pastures and other grazing land	7.01	6.3
5. Culturable waste	3.00	2.7
6. Land put to non agriculture use	7.130	6.9
7. Barren and unculturable land	04.56	4.1
8. Current fallows	2.00	1.8
9. Other fallows	1.89	1.7
10. Net area sown	49.83	44.72
11. Gross cropped area	87.34	78.39

Source : Deputy Directorate of Agriculture, Govt. of Orissa, Bhubaneswar.

Block profile

Barchana block comes under cuttack district and is situated in the North-West side of the district and lies between 20°39' N and 20°45' N latitude and between 85°43' E and 86°22' E longitude. This block is surrounded by Dharmagala block in the north and Tangi - choudwar block in the South, Mahange block in the East and Dhenkaral District in the west. The national highway (No.5) connecting Calcutta and Madras runs through the block and the South eastern Railway also passes through it.

The total geographical area of the block was 371.58 sq.kms with a population of 1,78,664 persons according to 1991 census.

Administrative setup:

This block contains 31 gram panchayats with 263 villages. Three JAO (Junior Agriculture Officer) circles and 24 VAW (Village Agriculture Worker) circles. The total number of farm families in this block is 22,487, there are 14 co-operatives societies and 3 Regional Rural banks facilitating the agricultural credit disbursement.

Land holding

There are 22,487 number of farms out of these farms 13,062 (58.08 per cent) were below 1 ha in size as marginal

farmers. In holding size of one to two ha. were 6971 farms and large farms of 2 ha. and above were 2454.

Irrigation

Different sources of irrigation were available in this study area such as canal, water lift and dugwell. the total cultivated land is 22,968 hectares and total irrigated land is 16,152 hectare. Source wise irrigation prevailing in the area are presented below in Table:5

Table 5. Source Wise Irrigation In Barehana Block In 1993-94

Source	area (ha)	
Canals	10759.00	44.84
Water lift	3227.00	13.45
Dug well	2155.00	9.02
Net area irrigated	16,152	66.31
Area irrigated more than once	7,840	33.67
gross area irrigated	23,992	100.00

Source : Assistant Directorate of Agriculture, Govt. of Orissa, Cuttack.

From Table:4. it can be seen that the irrigation potential is well developed in this block with 71.40 per

Table:6 Land Utilization Pattern In Barchana Block
(1994-95)

Details	Area (ha)	% of total geographic area
1. Cultivable waste	104.04	2.8
2. Current fallavs	74.31	2.0
3. Other fallows	55.73	1.5
4. Net sown area	20129.38	54.51
5. Sub total	20363.46	60.81
6. Area sown more than once	13236.24	35.62
7. Gross cropped area	33599.40	90.42
8. Net Area irrigated	16152.00	43.46
9. Gross Area Irrigate	23992.00	64.56
10. % of crop area irrigated	71.40	-
11. Cropping Intensity	165.13	-

Source: Junior Agriculture Officer, Department of Agriculture, Barchana

cent of the gross area being irrigated, which is well above the state average of 47.00 per cent. Moreover the cropping intensity is also 165.13 suggesting that farmers do reap the benefit of higher irrigation potential by taking crops in slack seasons also. All these data shows that Barchana is a predominantly agricultural block. The data of current fallows of 2.0 per cnet confirms that usually land is not left fallow.

Major crops

The major crops raised in the block are rice, sugarcane, groundnut and sesamum.. The seasonwise major crops grown are presented in Table:7.

Table 7 . Seasonwise Major Crops Grown In Barchana Block

Season	Major crops grown
i) Kharif	Paddy, Sugarcane, vegetables
ii) Rabi	paddy, groundnut, sesamum pulses, mustard
iii) Summer	pulses, vegetables

Cropping pattern

The annual cropping pattern followed in the Barchana block is presented in Table: 8

Table 8. Annual Cropping Schemes In Barchana Block

Situation	1st crop (Kharif)	2nd crop (Rabi)	3rd crop (Summer)
1. Rainfed			
a. Light soil	Rice (t)	Rabi	Summer
	G.nut	G. nut	vegetables
	Dry rice	Mustard	-
b. Medium soil	Direct seed rice	Pulses	-
	Sugarcane	Sesamum	
	-	Pulses	Rice
	Rice	G. nut Rice	vegetables -
2. Canal irrigated upto September			
a. Light soil	Rice	Mustard	Rice
	Rice	G. nut	Rice
	Sugarcane	Pulses	Rice
b. medium soil	Rice	Rice	-
	Rice	Rice	-
	Rice	Rice	-
	Sugarcane	Pulses	-

Contd...

Contd... Table 8.

Situation	1st crop (Kharif)	2nd crop (Rabi)	3rd crop (Summer)
3. Purely canal /LI irrigated			
a. Light soil	Rice	Rice	Rice
	G.nut	Rice	Rice
	Sugarcane	Rice	-
b. medium soil	black gram	Sesamum	-
	Rice	Rice	Rice
	Rice	Rice	Rice
	Rice	-	-
4. Purely well irrigated			
a. light soil	Rice	Rice	Rice
	Rice	G. nut	-
	-	Sesamum	-
		Rice	-

Table 9 Rice Varieties Recommended for the Block (Barchana)

S.No.	Varieties	Season
1.	Swarna	Kharif
2.	Pani Dhana	Kharif
3.	Deba	Kharif
4.	Lunishree (for marshy stirps)	Kharif & Rabi
5.	CR 1014	Khraif & Rabi
6.	Mahsuri	Rabi
7.	Jaganath	Kharif
8.	ADT 36	Kharif
9.	Hema	Rabi
10.	Short Duration rice	Summer

It could be observed that around 10 varieties were recommended for the area. But in actual practice farmers preferred CR 1014, Swarna and jaganath. In low land marshy strips adjoining the coastal strips Luhishree was mostly cultivated.

The cropping pattern followed in the sample block indicated that paddy is the main crop for all the seasons. So it is properly justified to carry out the study for rice in the Cuttack district.

Area covered under different varieties of paddy during 1993-94 and 1994-95 are presented in Table 7.

From the table it can be seen that the area under rice for all the varieties except HYV rice has reduced. Even though area under HYV rice had increased it was only a marginal increase. So the land devoted to rice has been either used for other crops or used for non agricultural purposes. The marginal increase in HYV paddy could be attributed to the reasons of, high cost involved and higher problems of pest infestation etc., related to this crop. Regarding yield of rice also it shows a declining trend along with a decrease. The yields also stand below the national average.

Table 10. Area under Rice during 1993-94 & 1994-95 in
Cuttack

Varieties	1993-94		1994-1995	
	Area	yield (Q/ha)	Area	Yield
Kharif rice	12801	41.7	11,800	39.8
Summer rice	5641	21.2	5049	20.6
Total rice	18442	29.4	16,849	30.2
HYV rice	3641	-	5336	-
Local Rice	12901	14,31	10816	12.37

Source : Assistant Directorate of Agriculture, Govt. of Orissa, Cuttack.

In sum the main strategy for development of the study area lies in developing the rice based farming. From the economic angle, efficient rice production is the optimal production, with optimum utilisation of existing resource constraints. So this study needs a break through.

Results and Discussion

CHAPTER V
RESULTS AND DISCUSSION

Results of the present study are discussed in this chapter. The chapter has been divided into five sections. Section-I describes the general characteristics of sample farms, Section II deals with the economics of rice production and efficiency measures for factor inputs. Section III is devoted to study the production function analysis. Section IV identifies the problems in getting capital for the farm operations. The chapter ends with Section V on risk analysis and optimal farm solution by E-V analysis.

SECTION - I FARM CHARECTERISTICS

In this section, details regarding the average resource position, level of capital use, gross farm output etc. are presented. Land is measured in terms of operational area, labour in terms of mandays. Three measures of capital are given in value term i.e. total value of farm assets, capital expenditure and current farm expenses. Gross farm output is measured in value terms and is computed by adding the receipts from all sources (i.e. sale of crops, livestock products and imputed value of output consumed by farm family).

Size of Holding and Tenancy*

The average size of holdings in different size groups is set out in Table 11.

The average size of operational holdings as based on the pooled data was 1.84 ha for the sample farmers of the study area.

When average size of operational holding was studied it was seen that the average size of the sample farms was only 1.84 ha. for the pooled data.

The details about the land ownership in different size groups of the study area are presented in Table 12.

As could be seen from the table, the percentage of owned land and leased-in land among the sample farm in the study region on an average worked out to 93.09 and 6.91 per cent respectively. Thus, for all the sample farms selected in both the areas owned land constituted more than three-fourths of their operational land and less than one fourth

* Operational holdings = (owned land + leased-in land + mortgaged-in land) - (leased-out land + mortgaged out land + wasteland)

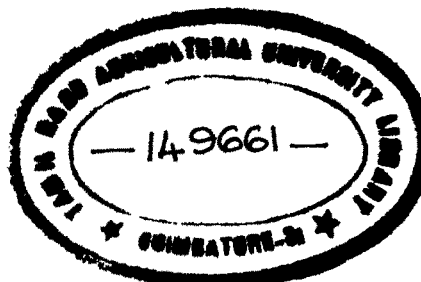
**Table:11. Distribution Of Holdings In Different Size Groups
of Sample Farms**

Size groups	No. of farms	% to total sample	Average size of operational holdings in hectares
I (below 1.00)	38	42.88	0.93
II (1.01-2.00)	20	22.20	1.37
III (2.01 and above)	32	34.92	3.35
Pooled	90	100.00	1.84

**Table:12. Distribution Of Owned And Leased In Land In Different
Size Groups Of Sample Farms**

(in ha)			
Size groups	Average size of operational holdings	owned land	Leased-In land
I	0.93 (100)	0.546 (58.6)	0.386 (41.4)
II	1.37 (100)	1.37 (100)	-
III	3.35 (100)	3.35 (100)	-
Pooled	1.48 (100)	1.35 (93.09)	0.13 (6.91)

Note : Figures in Parentheses Represent Percentage.



was added to it on share cropping basis. This indicated that the system of ownership cultivation was the common practice in the study area.

Irrigation:

The distribution of area under irrigation in different size groups of holdings is shown in Table 13.

The average irrigated area was 0.91 ha. for the samples available and its proportion to total operated area was 61.17 per cent for the study area.

Among different size groups the proportion of area under irrigation varied between 58.5 and 65.91 per cent. Thus, even in the area irrigated there was some unirrigated area.

Cropping Pattern:

The cropping patterns followed by the sample farmers are presented in Table 14.

The importance of paddy cultivation in the area comes out clearly in this survey. The share of area under paddy in GCA was 60.04 per cent for the sample farms. In this region the area covered under pulses, Sugarcane, Groundnut Mustard and Vegetables accounted for 8.78, 6.53, 7.28, 7.85

Table:13. Distribution Of Area Under Irrigation In Different Size Groups Of

Sample Farms

Size groups	Average size of Operational holdings (ha)	Area under Irrigation Per farm	Per ha.	Percentage (%)
I	0.93	0.613	0.66	65.91
II	1.17	0.75	0.64	64.23
III	2.35	1.37	0.58	58.50
Pooled	1.48	0.911	0.62	61.17

Table:14. Cropping Pattern Adopted In Different Size Groups Of Sample Farms.

Size group	Paddy	Pulses	Sugarcane	Groundnut	Mustard	Vegetables	Total
I	51.3	12.1	6.5	8.2	8.9	13.0	100
II	59.44	9.25	8.65	7.4	9.7	5.56	100
III	71.19	4.99	4.44	6.25	4.95	8.18	100
Pooled	60.64	8.78	6.53	7.28	7.85	8.92	100

(%)

and 8.44 per cent of the total cropped area respectively, indicating diversification of farming.

Intensity of Cropping:

The intensity of cropping as measured by the ratio of gross cropped area to net cropped area is presented in the Table 15 . As expected because of provision of irrigation the sample farmers of this region had achieved higher intensity of cropping . The average intensity of cropping being, 154.8 per cent for this region . A comparison of inter group differences in the intensity of cropping showed inverse relationship between size of holding and intensity of cropping in study area. The intensity of cropping varied from 143.52 to 175.71 per cent.

Labour:

The distribution of earners in agriculture among various size groups is shown in Table 16.

The workers, who earn more than fifty per cent of their earnings from agricultural sources were treated as agricultural class. Table 16 revealed that there was more family labour available for agricultural work in lower size groups (both small and medium) as compared to higher size groups. The average number of family workers available for agricultural occupation were 3.10, 1.80 and 2.05 in large,

Table:15. Intensity Of Cropping In Different Size Groups Of
Sample Farms

Size groups	Operational land (ha)	Gross cropped area (ha)	Cropping intensity (%)
I	59.02	103.72	175.73
II	27.4	43.1	154.29
III	107.2	153.8	142.50
Pooled	64.54	100.22	155.28

Note : i) Cropping Intensity = $\frac{\text{Gross cropped area}}{\text{Operational area}} \times 100$

ii) All figures represent totals of the sample farms.

Table:16. Distribution Of Family Labour In Different Size Groups
Of Sample Farms

Size groups	Total No. of earners per farm	No. of Agril.earner farm	% of earner in Agril. to total
I	2.05	1.78	84.82
II	1.80	1.60	87.88
III	3.06	2.06	67.32
	2.31	1.78	80.00

medium and small farms respectively. This meant that the total earners in agriculture were more in small and medium farms than large size farms. It also meant that a substantial proportion of earners in latter farm categories were engaged in non-agricultural activities while, in the former case they depended to a large extent on agriculture.

Bullock Labour:

Bullock power draught power for different operations in the farm. Table 17 showed the average number of bullock and the area operated by a pair of bullock in different size groups.

The average number of bullocks per farm in small, medium and large size groups were 1.15, 2.0 and 2.75 respectively. The corresponding figure per hectare were 0.74 1.45 and 0.82 respectively. This showed that there was a positive correlation between the farm size and the availability of bullocks per farm. However, the same was not true when viewed in the context of per hectare availability of bullock labour on the sample farms.

On an average the area commanded by a pair of bullock in the irrigated region worked out to 2.68 hectare in small, 1.37 hectares in medium and 2.43 hectares in large farms .

Table:17. Number of Bullocks in Different Size Groups of Sample Farms and Average Cultivated Area Per Pair of Bullock.

Size groups	No.of bullocks per farm	No. of bullocks per hectare	Area per pair of bullocks in hectares
I	1.15	0.74	2.68
II	2.0	1.45	1.37
III	2.75	0.82	2.43
Pooled	1.96	1.00	2.16

When all the size groups were pooled together it worked out to 2.16 hectares.

Capital used in sample Farms:

For the purpose of present study three measures of capital are presented and discussed below viz.,:

- (a) Value of farm assets
- (b) Capital expenditure
- (c) Current farm expenditure

Farm Assets:

The distribution of assets (per farm and per hectare) in different size groups under irrigated and non-irrigated regions are presented in Tables 18, 19, 20.

The average value of farm assets per farm and per hectare was worked out to Rs.2,30,777.56 and Rs.1,12,683.88 respectively. Among different farm sizes the large farmers had higher absolute value of assets both per farm and per hectare than medium and small farmers. As may be seen from the Table 18 that in the average value of assets per farm in small, medium and large farms were Rs.76,277.60, Rs.1,67,208.84 and Rs.4,48,849.14 respectively. The corresponding figures per hectare were Rs.71,266.24, Rs.1,22,048.17 and Rs.1,33,984.56.

Table:18. Value of Fixed Assets in Different Size Groups of Sample Farms.

Size groups	(Rs. / Farm)						
	Land	Live stock	Farm buildings	Agril. implements & machineries	Non-agril. assets	Financial Total assets	
I	66666.66	3400.35	2140.32	1656.10	1363.67	1050.50	76277.60
II	152800.00	5173.67	3080.34	2610.32	1532.10	2010.21	167206.84
III	413923.33	8080.33	7266.20	7046.12	6533.01	6333.15	448849.14
Pooled	211129.99	5551.45	4162.35	3770.85	3142.93	3020.29	230777.56

Note : All values are at 1994-95 prices.

Table:19. Value of Fixed Assets in Different Size Groups of Sample Farms

Size groups	Land	Live stock	Farm buildings	Agril. implements & mechinaries	Non-agril. assets	Financial assets	Total
I	71684	3656.29	2301.42	1780.75	1466.28	1129.57	82018.92
II	111532.85	3776.40	2248.57	1905.34	1118.32	1467.31	122048.17
III	123559.20	2412.04	2169.01	2103.32	1950.15	1791.01	133984.56
Pooled	102258	3281.58	2239.67	1929.80	1511.58	1462.66	112683.88

Note : All values are at 1994-95 price

Table:20. Percentage Composition of Fixed Assets in Different Size Groups of Sample Farms

Size groups	Land	Live stock	Farm buildings	Agril. implements & machineries	Non-Agril. assets	Financial assets	Total
I	87.40	4.46	2.81	2.17	1.79	1.37	100.00
II	91.38	3.09	1.84	1.56	0.91	1.22	100.00
III	92.22	1.80	1.62	1.57	1.45	1.34	100.00
Pooled	90.33	3.12	2.09	1.76	1.38	1.32	100.00

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with regard to the composition of assets land accounted for an over whelming proportion of the total value of asset holding irrespective of the farm size and type. It was as high as 90.33 per cent in the area studied. While comparison of percentage share of land on different farm sizes was made, it showed the highest investment on large farms whereas it was the lowest on small farms . Investment on livestock occupied position next to land followed by farm buildings and agricultural implements in that order .The investment on livestock accounted on an average 3.12 per cent . Farm buildings and agricultural implements and machineries accounted for 2.09 per cent and 1.76 per cent

Capital Expenditure:

Capital expenditure is the payment made towards acquisition of farm assets like land improvement, purchase of livestock, implements and machineries, non-agricultural assets, financial assets etc.

Tables-21, 22 and 23 present the extent and nature of capital expenditure incurred by the sample farmers during the year of study.

The average amount of capital expenditure incurred by the sample farms was Rs.3085.46 and Rs.1439.65 per farm and per hectare respectively. A comparison of capital

Table:21. Capital Expenditure in Different Size Groups of Sample Farms

	(Rs./Farm)				
Size groups	Land	Live stock	Agril. implements & machineries	Non-Agril. assets	Total
I	412.33	315.67	80.67	36.67	845.34
II	1010.15	710.16	234.13	130.00	2084.44
III	2989.68	1876.00	810.15	550.77	6326.60
Pooled					
	1470.72	967.28	408.32	239.15	3085.46

Note : All values are at 1994-95 prices.

Table:22. Composition of Capital Expenditure in Different Size Groups of Sample Farms.

Size groups	Land improvement	Live stock	Agril. implements & machineries	Non-Agril. assets	Total
I	443.36	339.43	86.74	39.50	909.03
II	737.33	518.36	170.89	94.89	1521.47
III	892.44	560.00	271.68	164.40	1888.52
Pooled	691.04	472.60	176.44	99.57	1439.65

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Table:23. Composition of Capital Expenditure in Different Size Groups of Sample Farms

Size groups	Land improvement	Live stock	Agril. implements & machineries	Non-Agril. assets	Total
I	48.78	37.34	9.54	4.34	100.00
II	48.46	34.07	11.23	6.24	100.00
III	47.25	29.65	14.39	8.71	100.00
Pooled	48.16	33.69	11.72	6.43	100.00

expenditure by farm sizes indicated that large farms invested a higher amount than the other size groups.

Among various items included in the capital expenditure land improvement emerged as the item on which largest percentage of investment took place. The higher proportion of such expenditure on land improvement in case of sample farmers of irrigated region was on construction of drainage channels and levelling of land. Among the remaining items purchase of livestock was relatively more important in capital expenditure in both the regions. The proportion of capital expenditure incurred on implements and machineries and non-agricultural assets was very small being on an average 11.72 and 6.43 per cent.

Current Farm Expenditure:

Generally current farm expenditure is divided into two parts viz., (a) non-cash expenditure and (b) cash expenditure. The non-cash expenditure includes items like family labour, owned bullock energy, value of farm grown seeds, farm produced manures etc. The cash expenditure refers to the amount spent by the farmer for purchase of seeds, fertilizers, plant protection materials, irrigation charges, livestock maintenance, hiring human labour and bullock power required for the farm. All these calculations took prevailing market price for arriving at expenditure.

Non-Cash Expenditure:

The value of resources met from own sources for production purpose on per farm, per hectare and percentage basis are shown in Tables 24, 25 and 26 respectively.

As could be seen from the table, the average non-cash expenditure per farm in small, medium and large farms were Rs.2,975.10, Rs.3,670.12 and Rs.5,994.61 respectively. The corresponding figures per hectare were Rs.3,209.78, Rs.2,679.14 and Rs.1,765.56 respectively. Thus the large farmers appeared to have incurred more non-cash expenditure per farm but on per hectare basis the small and medium farmers are found to spend more on such items. The higher level of non-cash expenditure on small and medium farms was largely due to the concentration of family labour on these farms.

Among different items included in non-cash expenditure, family labour constituted about 50 per cent 54.17 per cent followed by bullock labour 27.78 per cent. Owned seeds and manures formed only 13 to 15 percent. Thus, family labour was the only important item which accounted for the bulk of the non-cash expenditure among the sample farms.

Cash Expenditure:

The study of the cash expenditure a constituent of current farm expenditure throws light on the financial needs

Table:24. Non-cash Expenditure in Different Size Groups of Sample Farms

Size groups	(Rs./Farm)					Total
	Family labour	Owned bullock labour	Owned seeds	Owned manures		
I	1880.00	700.00	200.10	95.00		2975.10
II	2020.00	1020.12	480.00	150.00		3670.12
III	2729.00	1700.00	955.61	530.00		5994.61
Pooled	2209.67	1140.04	578.57	258.33		4159.27

Table:25. Non-cash Expenditure in Different Size Groups of Sample Farms

(Rs./ha)

Size groups	Family labour	Owned bullock labour	Owned seeds	Owned manures	Total
I	2021.50	752.89	333.444	102.15	3209.78
II	1474.69	744.61	350.36	109.48	2679.14
III	1161.27	507.46	285.26	158.21	1765.56
Pooled	1436.94	668.25	323.03	123.28	2551.49

Note : All values in 1994-95 price.

Table:26. Composition of Non-cash Expenditure in Different Size Groups of Sample Farms
(%)

Size groups	Family labour	Owned bullock labour	Owned seeds	Owned manures	Total
I	62.98	23.48	10.39	3.18	100.00
II	55.04	27.79	13.08	4.09	100.00
III	45.52	28.36	14.94	8.84	100.00
Pooled	54.17	27.78	13.53	4.52	100.00

of the farmers. The details of cash expenditure on per farm, per hectare and percentage basis are shown in Tables 27, 28 and 29 respectively.

It may be observed from the table that the average cash expenditure per farm in small, medium and large farms were to Rs.3,066.34, Rs.5,603.28 and Rs.16,833.36 respectively. Cash expenditure on per hectare basis, can be taken as a rough measure of intensity in the use of modern inputs. The average cash expenditure per hectare for the small, medium and large farms worked out to Rs.3,294.98, Rs.4,016.15 and Rs.4,965.12. Thus the large farms appeared to have incurred more cash expenditure both per farm and per hectare than their counterparts in small and medium farms. The high level of such expenditure in case of large size farms was on account of the heavy expenditure incurred on hired human labour and fertilizers. This indicated that the large farmers had achieved relatively a higher level of intensity in input use as compared to other farm categories.

Among different items included in cash expenditure hired human labour and fertilizers together accounted for the bulk 58.46 per cent of the total cash expenditure followed by bullock power and seeds 14.41 and 6.16 per cent.

Table:27. Cash Expenditure in Different Size Groups of Sample Farms.

Size groups	(Rs./Farm)								
	Hired human labour	Hired bullock labour	Purchased seeds	Fertilizers & manures	Irrigation charges	Plant protection	Implement & machineries	Misc expenditure	Total
I	1100.20	479.30	210.12	700.00	53.60	280.12	106.00	140.00	3679.34
II	1900.30	750.00	330.33	1301.50	122.00	550.15	290.00	350.00	5603.28
III	6500.00	1350.00	938.00	3500.10	217.46	1507.50	730.30	890.00	16633.15
Pooled	3166.83	1191.43	492.82	1833.87	130.02	779.26	375.43	460.00	8500.99

Table:28. Cash Expenditure in Different Size Groups of Sample Farms.

Size groups	(Rs./ha)								
	Hired human labour	Hired bullock labour	Purchased seeds	Fertilizers & manures	Irrigation charges	Plant protection	Implement & machineries	Misc expenditure	Total
I	1183.01	510.00	225.43	752.69	57.63	301.20	113.98	159.54	3294.98
II	1624.18	641.02	282.33	1112.39	104.27	470.21	247.86	299.15	4781.41
III	2765.53	1000.00	399.14	1489.42	92.53	641.48	310.76	378.72	7077.93
Pooled	1737.57	717.00	302.3	1218.16	84.81	470.96	224.2	279.13	5051.44

Table:29. Composition of Cash Expenditure in Different Size Groups of Sample Farms

Size groups	Hired human labour	Hired bullock labour	Purchased seeds	Fertilizers & manures	Irrigation charges	Plant protection	Implement& machineries	Misc expenditure	Total
I	35.90	15.48	6.86	22.84	1.75	9.14	3.48	4.57	100.00
II	34.53	13.64	5.99	21.99	2.22	9.99	5.27	6.37	100.00
III	39.08	14.13	5.64	21.04	1.31	9.06	4.39	5.35	100.00
Pooled	36.50	14.41	6.16	21.96	1.78	9.39	4.37	5.43	100.00

SECTION - II COSTS AND RETURNS →

An analysis of costs and returns provide a rough indication of profitability of farm business. However a general descriptive analysis of costs and returns is no substitute for a rigorous production function analysis which serves better as an indicator of the efficiency of factor proportions in production. Nevertheless, a study of costs and returns throws useful light on aspects which need careful scrutiny in a rigorous analysis. With this in view, an analysis is carried out on costs and returns of rice in the sample farms.

The concepts of costs and returns used in the present discussion are the same as generally adopted in Farm Management Studies conducted in the country.

Costs of Production:

The distribution of average cost of production and its break up in different size groups, in Table: 30.

It may be observed from the table that the cost of cultivation per hectare increased from Rs.6,600.35 on small farms to Rs.7212.39 on medium and to Rs.7802.91 on large farms. This showed that large farms appeared to have incurred expenditure relatively more as compared to their

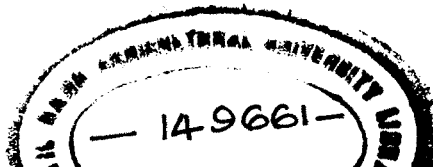


Table:30. Total Production Costs of Rice.

(Rs./ha)			
Item (1)	Small Costs <i>Jan</i> (2)	Medium Costs (3)	Large Costs (4)
A. Operational costs			
1. Human labour	1995.00 (30.22)	2200.04 (36.51)	2274.68 (29.15)
a. Family labour	1463.33 (22.17)	1183.35 (16.41)	430.43 (5.52)
b. Hired labour	531.67 (8.05)	1016.68 (14.10)	1844.25 (23.63)
2. Traction Power Bullock labour	1374.23 (20.82)	1482.89 (20.56)	1622.95 (20.80)
3. Seed and seed material	280.72 (4.25)	290.06 (4.03)	320.51 (4.11)
4. Plant protection	244.75 (3.71)	243.80 (3.38)	208.83 (2.68)
5. Fertilizer and manuring	270.65 (4.10)	300.29 (4.16)	357.24 (4.58)
6. Irrigation	42.19 (0.64)	49.83 (0.69)	45.35 (0.58)
7. Miscellaneous costs	16.96 (0.26)	21.38 (0.29)	44.94 (0.57)
8. Interest on working capital	84.89 (1.29)	78.81 (1.09)	160.05 (2.05)
Total operational costs	4309.39 (65.29)	4467.10 (64.71)	5034.55 (64.52)

Contd...

Table:30 Contd.,

Item (1)	Small Costs (2)	Medium Costs (3)	Large Costs (4)
B. Fixed costs			
1. Depreciation	87.89 (1.32)	145.00 (2.01)	2100.00 (2.68)
2. Rental value of owned land	2085.43 (31.59)	2230.29 (30.92)	2298.36 (29.45)
3. Interest on fixed capital	117.64 (1.76)	170.00 (2.36)	260.00 (3.35)
Total fixed costs	2290.96 (34.71)	2545.29 (35.29)	2768.36 (35.48)
Total costs (A + B)	6600.35 (100.00)	7212.39 (100.00)	7802.91 (100.00)

* Figures in parenthesis indicates percentage of total costs

counterparts in medium and small farms. The high level of such expenditure in case of large size farms was on account of heavy expenditure incurred on human labour, bullock labour and fertilizers. It further indicates intensive use of factor inputs on large size farms.

Total costs of cultivation varied from Rs.4,309.39 on small farms to Rs.5,034.55 on large farms. However, the per cent share of the variable cost showed an inverse relationship with farm size. It accounted for 65.29 per cent on small farms 64.71 per cent on medium farms and 64.52 per cent on large farms.

In case of fixed costs there was a direct relationship between size of the farm and fixed cost. The total fixed cost in case of small, medium and large farms were worked out to Rs.2290.96, Rs.2545.29 and Rs.2298.12. This constituted 34.71, 35.29 and 35.48 per cent respectively for small, medium and large size groups.

The table indicated that irrespective of the farm size and type among the various cost components maximum expenditure was on to rental value of land followed by human labour, bullock power, manures and fertilizers used. The rental value on land was Rs.2298.36 on large farms, Rs. 2085.43 on small farms Rs.2230.29 on medium farms. The

percentages shares of this component in total expenditure were 31.59, 30.92 and 29.45 per cent for small, medium and large farms respectively. This showed an inverse relationship with farms size.

The next important component of the total cost of cultivation in rice was human labour and bullock power, which were Rs.1,995.00 and Rs.1374.23 on small farms Rs.2200.04 and Rs.1402.89 on medium farms; and Rs.2274.68 and Rs.1622.95 on large farms respectively. This indicated rice cultivation was labour intensive.

The third major item in the total costs was manures and fertilizers which accounted for Rs.270.65 on small, Rs.300.29 on medium and Rs.357.24 on large farms which also indicated direct relationship with the farm size.

The next important one was cost of seed which accounted for Rs.280.72 on small farms Rs.290.06 on medium farms and Rs.320.51 on large farms. The percentage share for these farms worked out to 4.25, 4.03 and 4.11 for the region, in small, medium and large farms respectively.

Among the fixed costs, land revenue, depreciation and interest on fixed capital put together accounted for Rs.205.53 on small farms Rs.315.00 on medium farms and

Rs.470 on large farms respectively. These items put together increased with increase in the farm size.

Unit Cost of Production:

For further analysis of farm business indepth, the unit cost of production was calculated and presented in Table: 31.

The table revealed that the productivity was the highest on large farms followed by medium and small farms. The average yield of rice per hectare was 50.0 quintals on large farms, 45.8 quintals on medium and 40.9 quintals on small farms. Thus, the physical yield per hectare indicated direct relationship with farm size. Though it contradicted the common belief of better yield in small farms, it can be explained that large farms were found to be more efficient in input use.

The per quintal cost of production of rice was the highest on small farms, at Rs.161.37 followed by Rs.157.47 on medium farms and Rs.156.06 on large farms.

Thus the unit cost of production revealed the efficiency of different farms. Hence it could be concluded that large farms were economically most efficient followed by medium and small farms.

Table:31. Unit Cost Of Production And Productivity In Rice Farm

Items	Small	Medium	Large	Pooled
Gross cost/ha	6600.35	7212.39	7802.91	7205.22
Yield in quintal/ha	40.90	45.80	50.09	43.76
Cost of Production of paddy/quintal	161.37	157.47	156.06	164.65

Cost Concept:

It was felt that study of farm business analysis using different cost concepts would provide additional information for this study. Hence, the cost concepts used for this analysis were cost A₁, cost A₂, cost B and Cost C. Estimates of different costs per hectare by farm type and size are given in Table: 32.

Gross Farm Income and Net Farm Income:

For the present study the gross farm income was estimated by multiplying output of different farm enterprises by their respective prices and by adding all receipts (crops, livestock and their by-products). The estimated cost of production (i.e. current farm expenditure) was subtracted from the estimated gross farm income to arrive at the net farm income.

The estimate of gross farm income, cost of production and net farm income are presented in Table: 33.

The average net farm income, (per farm) for all the size groups of farms Rs.9,732.05 and Rs.7,237.12 respectively. Per hectare, it amounted to Rs.5,323.36 in the study area.

Table:32. Structure Of Production Cost On Rice Enterprise

(Rs./ha)

Size group	Cost A ₁	Cost A ₂	Cost B	Cost C
Small	2933.95 (44.45)	4023.14 (60.95)	5137.02 (77.83)	6600.35 (100.0)
Medium	3628.74 (50.31)	3628.74 (50.31)	6029.03 (83.59)	7212.39 (100.0)
Large	4814.12 (61.69)	4812.12 (61.69)	7372.48 (94.48)	7802.91 (100.0)
Pooled	3792.27 (52.63)	4155.33 (57.67)	6179.51 (85.76)	7205.22 (100.0)

Note : Figures in parantheses Represent Percentage.

Table:33. Gross Farm Income, Current Farm Expenditure and Net Farm Income on Per Farm and Per Hectare Basis in Different Size Groups of Sample Farms.

(Rs.)

Size groups	Per Farm			Per hectare		
	Gross farm income	Current farm expenditure	Net farm income	Gross farm income	Current farm expenditure	Net farm income
I	11500.60	6041.94	5459.16	12366.24	6496.17	5870.07
II	16260.37	9273.37	6987.00	11868.88	7925.25	5100.00
III	39577.97	22827.97	16750.00	11814.31	9714.02	5000.00
Pooled	22446.31	12714.26	9732.05	14368.58	8043.38	5323.36

Studied size group wise seen from the table that the per farm net income earned by different farm sizes was Rs.5,459.16 for small farms, Rs.6,987.00 for medium farms and Rs.16,750.00 for large farms. Thus the size of the farm was a major determinant of the net farm income and it could be explained by the variations in cropping intensity and cropping pattern as related to the farm size as discussed earlier.

Measures of Farm Income:

For a detailed analysis, farm income is measured in terms of net income, family labour income, farm business income and farm investment income. The various measures of farm income were calculated and presented in Table: 34.

It is seen from the table that the net income of large farms recording the highest income followed by medium and small farms. The average net income was Rs.1502.91 for the rice farms. The per cent share of net income to gross income was 15.24 on small farms, 15.54 on medium farms and 20.36 on large farm.

On an average, family labour income of Rs.2650.15, Rs.2510.12 and Rs.2425.58 per hectare were realised on small, medium and large farms respectively.

Farm business income ranged from Rs.3764.03 on small farms to Rs.4983.94 on large farms, with an overall average of Rs.4552.69. This shows positive relationship between per hectare farm business income and the farm size. The per cent share of farm business income to gross income was 48.34, 57.50 and 50.86, on small, medium and large farms respectively.

Factor Efficiency:

The efficiency of factors was worked out and presented in Table: 35.

Of all the factors, land showed the highest efficiency which also exhibited a direct relationship with farm size. The efficiencies were 174.5 and 152.69 in irrigated and non-irrigated farms respectively.

The overall farm efficiency was found to be high on large farms with 152.09 followed by medium farms with 143.31 and small farms with 142.17, with an overall efficiency of 145.52. The above trend showed large farms were more efficient in comparison to small and medium farms.

Table:34. Farm Income Measures In Rice Farm

(Rs./ha)

Particulars	Small	Medium	Large	Pooled
Gross income	7787.17	8539.15	9798.06	8708.11
Net income	1186.82 (15.24)	1326.76 (15.54)	1995.15 (20.36)	1502.91
Family labour income	2650.15 (34.03)	2510.12 (29.39)	2425.58 (24.75)	2528.62
Farm business income	3764.03 (48.34)	4910.10 (57.50)	4983.94 (50.86)	4552.69
Farm investment income	2300.70 (29.54)	3726.74 (43.64)	4553.51 (46.47)	3426.98

* Figures In parantheses Indicates Percentage Of Gross Income.

Table:35. Efficiency of Factor Inputs.

(%)

Factors	Farm category			
	Small	Medium	Large	Pooled
Land	171.68	172.88	178.94	174.50
Human Labour	168.35	170.40	176.17	171.64
Bullock labour	148.54	149.57	160.41	152.84
Seeds	124.04	123.84	131.56	126.15
Mannures and Fertilizers	122.84	123.89	132.23	126.32
Irrigation	118.59	119.29	127.25	121.70
Overall farm	142.17	143.31	151.09	145.52

SECTION - III PRODUCTION FUNCTION ANALYSIS

To estimate the marginal value productivity of farm inputs and to evaluate the resource use efficiency of the enterprise, the per hectare production function of Cobb-Douglas form was fitted.

Among the different types of production function Cobb-Douglas was chosen, as it was the best fit obtained. 87 observations were fed for the regression analysis for the study area.

This function had several advantages: first it was convenient to find out the elasticities of production which indicate the percentage change in output as percentage change in input use. The sum of production elasticities ($\sum b_i$) indicated, the nature of returns to scale. The sum when equal to one indicates constant returns to scale, means an increase in all factors of production by the same proportion would increase the output by same proportion. If sum was less than one it indicated decreasing returns to scale, while if the sum was more than one it indicated increasing returns to scale.

The only important limitations of this production function was that it allowed either constant, increasing or

decreasing marginal productivity but not an input-output curve embracing all the three stages.

The problem of multicollinearity (if any) was studied by constructing zero-order correlation matrices and it was found to be not very high.

The estimated regression co-efficient and other related statistics pertaining to individual farm size groups as well as pooled data size groups in Table: 36.

Co-efficient of Multiple Determination (R^2)

The co-efficient of multiple determination (R^2) measured the proportion of the variation in the dependent variable which could be explained by the specified independent variables.

It could be observed from the Table: 36 that the coefficient of multiple determination (R^2) was 0.8612, indicating that 86.12 per cent variation in gross return from paddy could be explained jointly by all explanatory variables. High and significant R^2 values showed the goodness of fit.

Production Elasticities

The results of the regression analysis indicated that the regression co-efficients associated with land area came

positive and significant for one per cent level of significance. So it could be said that one per cent increase in the land area would *Ceteris paribus* increase the gross return by 0.63 per cent from its mean level. The next variable, human labour (X_2) also had positive and statistically significant value of (0.4715). So one per cent increase in labour would *Ceteris paribus* increase the gross return by 0.47 per cent at the mean level. The fertilizer use (X_4) also, had a positive and statistically significant coefficient. It indicated that the production elasticity of rice for fertilizer application was 0.3204. The coefficients of other inputs such as seeds, plant protection and irrigation were not statistically significant, indicating that they had, at the mean level, no influence on yield of paddy. It might be due to standardization of their use, with little inter farm variations in the rate of their application.

Returns to scale

The sum of elasticities of resource was a measure of the returns to scale. It was 1.26 and indicated increasing return to scale.

Thus the paddy cultivation in the study area could be increased by increasing use of labour and fertilizers from their mean levels and by increasing area under the crop

Table:36. Co-efficient Of Regression (bj), Coefficient Of Multiple Determination (R^2), Standard Error and Value of D.W. Test for the Production Function Analysis.

Items	Irrigated
Land (X_1)	0.6365 * (0.2197)
Human Labour (X_2)	0.0815 * (0.0339)
Bullock labour (X_3)	0.0083 NS (0.0133)
Fertilizer (X_4)	0.3204 * (0.1274)
Seed (X_5)	0.1663 NS (0.2777)
Plant protection (X_6)	0.0220 NS (0.0257)
Irrigation (X_7)	-0.0284 NS (0.0189)
Returns to scale (bi)	1.2066

R^2 = .8612
 Constant = 4.3817
 D.W.test = 1.3194

* Significant at one per cent level of probability

** Significant at five per cent level of probability

NS Non significant

(land), and there was also the advantage of increasing returns to scale. This inference brought attention immediately to the question of resource use efficiency.

Resource Use Efficiency

The production function analysis was used to arrive at the efficiency of resource use. The general approach for judging the efficiency is comparing MVP X_i with the respective PX_i . If ratio was less than one it indicated that the resource was used in excess (than what was optimal). Optimal use was achieved when the MVP X_i was equal to PX_i . The ratios of MVP X_i to PX_i are given in Table: 37. This analysis was carried out only for the land, labour and fertilizer which had statistically significant coefficients. The ratio of MVP X_i to PX_i was greater than unity for land, labour and fertilizer showing that they were at present used at less than optimal level. Farmers would gain in profit by increasing their application from the present level of their use.

Table:37. Ratio Of MVP X_i To PX_i of The Respective Inputs

Item	

Land	2.304
Human labour	0.489
Fertilizer	2.231

SECTION - IV CAPITAL SCARCITY AND ASSOCIATED PROBLEMS

For all the farmers in each size group it was observed that the net income from farming was lower in comparison to the gross house hold expenditure. The difference in the gross expenditure and net income was termed as dissaving, so no-doubt this ammount of cash was either borrowed from friends, other family members or institutional agencies. But most of the farmers showed their preference for non-institutional agencies such as village landlords and professional money landers. Based on the opinion survey farmers were asked to rank the reason for preferring to borrow from non-institutional sources. The data was processed by Garrett's rank correlation test and is presented in Table: 38.

By a study of the details in Table: 38 it could be concluded that easy availability of cash, timely availability and less complications in procedure ranked among the first three reasons stated by the farmers. Opinion also showed that institutional facilities were available but they did bring little benefit to the farmers.

**Table:38. Garrett's Score Ranks for the Reasons of Choosing
a Particular source of Credit.**

Reasons	Score	Rank
1. Easy availability	63.14	I
2. Timely availability	56.54	II
3. Less complicated	56.00	III
4. Repayment is simpler	50.00	IV
5. Can be repaid in kind also	29.67	V
6. No institutional facility	29.67	VI

SECTION - V RISK PROGRAMMING

As stated earlier the programming models help in deriving optimal plans for the given returns of crops (c_j), resources (b_j) and constraints (a_{ij}). It is reasonably certain to state farmers' objective is to maximise aggregate net returns of farms by efficient organisation of available resource such as land, labour, and capital. It constitutes his decision behaviour. The objective of maximising net returns from a combination of enterprises subject to several constraints was normally decided with the help of Linear Programming method. The limitation of the method was the assumption of certainty values of the parameters.

It was difficult to justify the assumption in the context of complexities of the real world. Particularly the risk associated with the farm income would need attentions, for this purpose MOTAD model was appropriate and as good as QP model. In MOTAD model the objective function was maximising the variance for a specified level of income, usually increases with increasing returns. In other words if variance can be viewed as risk, high income farms would have risk also.

In general farmers are risk averse. Therefore to minimise risk would be their goal. The MOTAD model would

present than various combinations of risk and income levels and a choice was left to them. The set of risk income combinations would present an E-A (Expected income, Absolute deviation) frontier.

To arrive at E-A frontier the MOTAD was run five times for five different levels of income. Before fixing the income levels, a LP was run without the risk components, to arrive at the optimal income with conditions of certainty. It was Rs.8276/-. So for the MOTAD run 1 a higher income of Rs.10,000/- was fixed arbitrarily and it was raised in successive runs. The result of optimisation of different income levels are presented in Table :40.

Table:40. Results of Optimisation of Different Income Levels

Crop activities	Run 1	Run 2	Run 3	Run 4	Run 5
X ₁	0	0	0	0.231	0.292
X ₂	0.253	0.333	0.36	0.285	0.3
X ₃	0	0	0	0	0
X ₄	0	0	0	0	0
X ₅	0	0	0	0	0.167
X ₆	0.491	0.524	0.598	0.631	0.612
X ₇	0	0	0	0	0
X ₈	0	0	0	0	0.07
X ₉	1.186	1.171	1.10	0.898	0.694

Table:40 Contd...

Crop activities	Run 1	Run 2	Run 3	Run 4	Run 5
Assumed Income (Rs.)	10000	11500	14000	15500	16000
Expected Income (Rs.)	9086	11357	13619	15190	16175
A	738.57	1068.32	1413.14	1932.80	2459.50

RUN 1

This run had the expected income level of Rs.10,000/-. The optimal solution for this level of income was to cultivate Paddy-2 (X_2) with 0.253 ha, Sugarcane (X_6) with 0.491 ha and Blackgram (X_9) 1.186 ha. In this run Land I was completely used and it gave a shadow price of Rs.1133.25. Land II was not fully utilised and 0.3871 had been left out. Labour I slack showed 3263.02 m.hrs is excess and 3292.34 mhrs for Labour II. The capital I, II slack of Rs.4788.83 and Rs.3242.37 showed that this plan was not bound by capital scarcity. This plan also did not use 52.5 ha.cm of water in season I and 49.85 ha.cm of water in season II. In this solution the optimal combination of crops would yield an aggregate net income of Rs.9086 and it would be associated with an absolute deviation of risk value of Rs.738.57.

TABLE I. MOTAD MODEL

Item	Paddy I	Paddy II	Group-nut I	Group-nut II	Sesamum	Sugarcane	Bhendi	Mustard	Blackgram	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	RHS
Objective function																
Expected income (Rs.)	672133	648651	44429	106841	436301	1564693	319719	577552	264784							
Land I (ha)	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	16
Land II (ha)	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	16
Labour I (Hrs)	136805	0	112720	0	58950	248040	178613	238866	145948							6015
Labour II (hrs)	0	96468	0	159129	0	165295	0	0	0	0	0	0	0	0	0	4019
Capital I (Rs.)	401981	0	262994	0	44378	967489	134259	159500	100000	0	0	0	0	0	0	9930
Capital II (Rs.)	0	481981	0	537694	0	896174	0	0	0	0	0	0	0	0	0	6929
Water I (ha. cm)	19345	0	10	0	5	6546	2250	25	30	0	0	0	0	0	0	1152
Water II (ha. cm)	0	99	0	60	0	5455	0	0	0	0	0	0	0	0	0	7689
Risk rows																
Year 1	175742	14916	55119	84954	51809	69158	57325	35764	42469	0	0	0	0	0	0	0
Year 2	69728	-74864	-5796	-57382	17017	-82211	65122	94682	-32395	0	1	0	0	0	0	0
Year 3	-19961	-92324	72139	-168574	-78770	70788	-101271	-190746	-4748	0	0	1	0	0	0	0
Year 4	179627	-109699	52339	184947	63531	-140124	-189860	3220	36867	0	0	0	1	0	0	0
Year 5	94958	43251	68782	69013	96262	50546	69499	8252	4653	0	0	0	0	1	0	0
Year 6	88499	81522	6366	15868	7214	31746	65205	48829	26596	0	0	0	0	0	0	0

RUN 2

The second was performed with an expected income level of Rs.11,500/-. Optimal plan obtained from it showed an expected income of Rs.11,357 with risk value Rs.1068.32, which was more than that of Run 1. so this proved that when income increased the value of risk also increased. This run recommended 0.333 ha of Paddy II, 0.524 ha of Sugarcane and 1.171 ha of blackgram. This plan fully utilised the land I and left 0.289 ha of unutilised land II. In labour 1, 3167.36 m.hrs were in surplus and in labour II, 2971.59 m.hrs was in excess. The farm also showed a capital surplus of Rs.3975.95 in season I and Rs.2153.33 in season II. the water slack was 49.4 ha.cm and 26.59 ha.cm for second season.

RUN 3

The expected income value was fixed at Rs.14,000/- and the total absolute negative deviation value (objective value) was Rs.413.140 higher than the last run, with an expected income of Rs.13,619. The optimal solution allocated 0.36 ha to paddy II, 0.598 ha to sugarcane and 1.10 ha to blackgram. The land I and II were fully utilised so the shadow price was Rs.1208.3 and Rs.176.57. The labour 1 slack was 3065.01 m.hrs and labour 2 slack was 2654.67 m.hrs. which was in excess. The capital was Rs.3105.98 and capital II of Rs.1040.95 was in 45.85 ha.cm. and 4.57 ha.cm was in excess for season I and season II respectively.

RUN 4

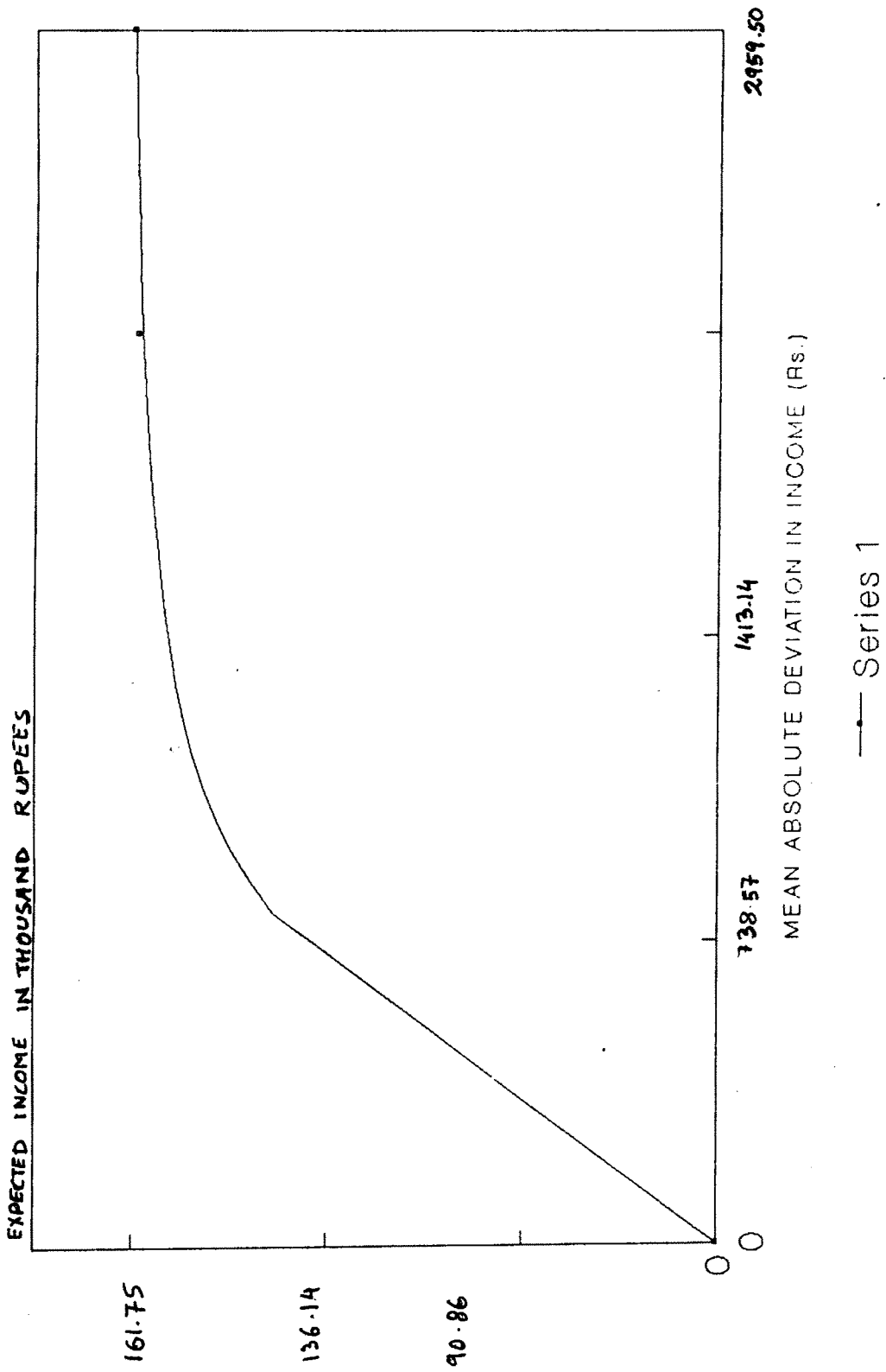
The expected income level for Run 4 was Rs.15,000/- and the objective function value came as Rs.1732.80. In this run Paddy I entered for the first time 0.231 ha. Paddy II 0.285 ha, 0.631 of sugarcane and 0.898 ha of Blackgram. The E-A combination was Rs.15,190/- and Rs.5798.60. The land I and land II were totally utilised, and their opportunity cost came to Rs.2193.77 and Rs.1652.04 respectively. The labour I was in excess of Rs.2909.82 m.hrs and II season labour was in excess of Rs.2529.88 m.hrs. The excess capital I was Rs.1407.19 and capital II was fully utilised. The water slacks showed water I was 21.77 ha.cm in excess and water II was 11.99 ha.cm in excess.

RUN 5

The final run was carried out at an expected income level of Rs.16,000. Here six crop activities entered the optimal solution. They were 0.292 ha of paddy I, 0.3 ha of paddy II, 0.167 ha. of sesamum, 0.612 ha. of sugarcane, 0.07 ha. of mustard and 0.69 ha. of blackgram. Total income expected from these crops was Rs.16,175 associated with total absolute deviation of Rs.2459.50.

This relationship was plotted to derive an E-A frontier and it is presented in figure.1. Every point on the E-A frontier represented an optimal plan associated with a level of income and a level of risk. As income increased risk also increased and it would be a movement away from

FIG.2 THE EFFICIENT E-A FRONTIER



origin along the E-A frontier and the farmer was free to choose any one of the points, all of them being feasible and optimal for the given set of resource constraints. Actual choice of a point by the farmer would depend upon his income-risk preference of the farmers. The farmers who were relatively more risky would choose points closer to the origin and those who were ready to accept larger risk could move away from the origin and get larger income. For each optimal combination of E and A the crop mix that contributed the income was seen in the optimal solution.

The E-A frontiers for the study area are presented in figure 1. The E-A curve showed that at E value zero (origin) A value was also zero. At Rs.10,600, it increased at increasing rate from income value of Rs.13,360 to Rs.18,700 at increased at decreasing rate. After Rs.18,700 the curve tended to be parallel to X-axis. The values on the parallel to segment of the curve showed very high increase in risk (absolute deviation), when income was also high. However, farmers were rarely risk takers, most of them would be averse to risk and this choice would be on combinations of crop mix represented by the rising part of E-A frontier. Higher the aversion of farmers to risk, closer to the origin would be their point of choice. any policy support to protect them against risk, (i.e) Any measure that absorbed part of the Total Absolute Deviation (A), would encourage them to move forward to realise higher income level.

Summary and Conclusion

CHAPTER VI

SUMMARY, CONCLUSIONS AND IMPLICATIONS

In this chapter, a summary of work done and findings of the study is presented, conclusions are drawn with reference to the objectives of the study and their implications for policy and further research are highlighted.

Focus

The present study was undertaken in the Barchana block of Cuttack district. The general objective of the study was to understand the decision making behaviour of farmers in rice production with special reference to the risk and capital scarcity. The specific objectives were:

- i) to analyse the economics of rice production;
- ii) to study the extent of risk and uncertainty in rice production and farmer's response to it (behaviour of risk aversion);
- iii) to evaluate the scarcity of capital if any, its causes, consequences and remedies;
- iv) to develop plans appropriate to maximise net returns from rice and under conditions of risk and assumption of certainty; and
- v) to suggest specific action plans for the farmers and policy support necessary to help them.

Methodology

The study was based on primary data collected from a sample of rice growers in Cuttack district in Orissa. In this district based on irrigation potential and acerage devoted to rice Barchana block was chosen as a representative of rice economy of the district. In the block 10 villages and in each village nine farmers were selected randomly. Thus, the ultimate sample consisted of 90 farmers, who were post-startified into three size groups of small (0 to 1.0 ha), medium (1.0 to 2.0 ha) and large (2.0 ha and above) to know the effect of farm size on returns and risk in rice cultivation.

The sample farmers were personally contacted and required data were collected by interview method. This primary data were processed and analysed with reference to the objectives of the study. Findings are stated below briefly.

Findings

Irrigation

The average area irrigated expressed as percentage of total cultivated area came to be 61.17 per cent far higher than that of the state average of 47 per cent. It was also seen from the table that small farmers had better irrigation intensity than the large farmers.

Cropping Pattern and Cropping Intensity

It was observed that the cropping pattern was well diversified. Still rice was the major crop revealing the farmer's preference to food crops. As expected the cropping intensity was quite high in the block, it stood at 155.28 per cent. The cropping intensity was also higher for small farmers than the large farmers.

Labour

In the study area, mostly bullock power and human labour were used. There were around 2.3 members per farm family, engaged in agricultural work. Around 1.96 bullocks were used to cultivate per farm. Area operated by a pair of bullocks in the block was 2.16 ha.

Value of Assets, Non cash Expenditure, and Cash Expenditure

It was seen that value of assets and the cash expenditure were both positively related to farm size. But non-cash expenditure put an entirely different picture. The cash expenditure on per farm basis was positively related to farm size yet on per hectare basis it was inversely related to farm size. This implied that small farms were less efficient in making cash expenses for crop production. This might be due to relatively poor bargaining power in the input market, including credit.

Costs and Returns

The study showed that the large farms reported to have incurred higher cost of production as compared to their counterparts in medium and small farms. On an average the cost of production of rice per hectare was Rs.6600.35, Rs.7212.39 and Rs.7802.91 in groups I to III. The respective break up of cost showed that irrespective of farm size, maximum share of the cost was due to rental value of owned land. It was only imputed and not actually paid out by the farmers. Therefore real cost was larger than the accounting cost of production. The cost of production per quintal of rice came to be Rs.161.37, Rs.156.50 and Rs.157.47 for the small, medium and large farmers respectively.

The gross returns per hectare showed that large farms had higher gross return per hectare followed by medium and small farms. The gross returns varied from Rs.7787.17 on small farms to Rs.9798.06 on large farms. Net returns realised also showed a direct relationship with the size of the farm. The net returns were Rs.1186.82 to Rs.1995.15 for size group I to III.

The study also revealed the farm income measured in terms of net income, family labour income, farm business income and farm investment income showed a direct

relationship with the farm size. All efficiency factors were also positively related to the farm size.

Production Function Analysis

In order to evaluate the resource use efficiency Cobb-Douglas production function was fitted to the per hectare input output data.

The coefficient of variables land, labour and fertilizer were significant indicating that they had the potential to augment the rice production from its mean level. Land came to be most significant value. For the analysis R^2 obtained was 0.8712 suggesting that 87.12 per cent of variation in gross returns of this crop could be explained by all the specified variables jointly.

Returns to Scale

The sum of elasticities was 1.26 showing an increasing return to scale prevailed in rice cultivation in Cuttack.

Resource Use Efficiency

The analysis showed that land and fertilizer had more than unity ratio of MVP X_i to PX_i suggesting that they were used inefficiently by the farmers and resource adjustment can be done to increase the production.

Problems Associated with Capital Scarcity

Based of Garrett's ranking technique, it was seen that farmers usually preferred the non-institutional credits, mainly for timely availability and less complicated procedure. This was strengthened by the fact that though the institution like co-operative banks, Gramya banks existed there, farmers never preferred it.

Risk Programming

The results obtained from optimization of 5 different income levels showed that with the increase in expected income the total absolute deviation (A) also increased. With Rs.10,000 income level A obtained was Rs.738.57 which increase to Rs.2459.50 at the expected income level of Rs.16000. This data were plotted in a graph, which showed that the E-A curve gets flattened after a certain limit suggesting lesser increase in income, but very high increase in variance. Obviously farmers would not select this region. But their selection will be nearer to origin with less variance.

Conclusion.

The above summary of finding led to three specific conclusions. (a) First, rice production was economically viable as shown by the positive net returns and other measures of economic viability. Secondly (b) cost of

production per unit decreased and all measures of income increased with the size of the farm. Definitely large farms were economically more benefited. Viewed in the context of predominance of marginal and small farms in the study area it would suggest priority for small scale farming in ressearch and policy. Probably consolidation of holding or some way of collective farming may be more advantageous. Thirdly, (c) risk in rice production increases with the rise in income level. Therefore, any excercise to optimize risk income trade off would be socially advantageous; especially in small and marginal farmers dominating economy where the risk eversion is large.

Policy Implications

The following policy implications could be done from the summary and conclusions presented.

1. Economics of rice production showed that net return is positively correlated with farm size. Therefore increasing the operational area of the farm would be a cost saving way of rice production. It would be possible to do this through cooperative or group farming. Policy should encourage such effort.
2. Production function analysis suggested that the resource adjustments of land, labour and fertilizer use will bring in more returns. Moreover the marginal

efficiency ratio showed the possibilities of resource adjustments.

3. The analysis of problem associated with credit showed that the institutional agency should be more simpler in their official rules to facilitate better loan disbursement. Also it should tally with the farming schedule for timely availability of money.
4. The risk study indicated that with higher income risk is also more. Efficient management of risk requires optimal production plans. Farmers should be educated and assisted to prepare optimal plans through demonstration and guidance.



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