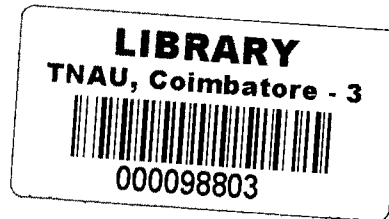


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FINANCING FARM DEVELOPMENT IN TAMIL NADU -
AN ECONOMIC ANALYSIS

By

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CHAPTER I

INTRODUCTION

General

Agriculture continues to be the major sector of Indian economy. It provides wherewithal for 70 per cent of population, contributes around 40 per cent of Gross Domestic Product¹, feeds and clothes the teeming millions albeit insufficiently, runs the wheels of industries by supplying raw materials and earns the much needed foreign exchange to finance economic development. However, agriculture, though having varied and great potentialities, has been stagnant as evidenced by a constant growth rate of 2.5 per cent². This has been attributed to the vicious circle of low income, low savings and low investment resulting in low savings. To break this vicious circle infusion of more funds into the agricultural sector has been suggested as an imperative remedy. Further with the recent technological breakthrough in agriculture, returns on capital investments have become attractive. However, most of the modern farming techniques are capital intensive and are focussed on irrigated agriculture. Any substantial increase in agricultural output can, therefore, be achieved either by development of relevant technologies to the rainfed agriculture or by conversion of rainfed dry lands

¹Commerce, Annual Number, 1974, p.217

²Ibid., p.217.

into irrigated area or a combination of both. This transformation, in pattern and techniques of farming requires larger investments on a continuous basis for some specified period.

Failure of many farmers to do things by which they can increase their income is often caused by lack of funds which is again due to a meagre savings due to low productivity and income. Moreover, farmers prefer to keep their meagre savings in liquid form mainly to meet the needs for running expenses of farm and home, besides keeping them to cover risks both in production and marketing. To make an initial breakthrough for sustained growth in output and income, substantial efforts for large investment in agriculture is necessary and to finance such investment credit is indispensable. Thus credit has been recognised as an instrument of growth.

Agricultural credit

The different channels through which credit flows into the agricultural sector are private, institutional and governmental agencies. Quantum, timeliness and terms and conditions of credit varies with the channels.

As far as the Indian agriculture is concerned, till the recent past private credit agencies were playing the major role. But in view of the evils beset in the system like usurious rate of lending and insufficient quantity,

it was considered essential to break its strangle hold. Hence institutional and government agencies were made to take a more and more predominant role in financing agriculture.

The credit, depending on the time period for which it is required, is classified as short, medium and long-term. Institutional and government agencies cater to these requirements. During the First and Second Five Year Plans the emphasis was for advancing short-term operational credit to the farmers. The reasons may be that the government would have aimed to reap the benefits of the green revolution by increasing the productivity of land. It was later felt that the structural transformation of the farms were also as well necessary for concerted development and therefore co-ordinating the long-term credit with short-term credit was planned. From 1950-51 to 1960-61, the first and second plan periods, the proportion of long-term credit in the total co-operative credit was only around five per cent. During 1965-66, i.e., at the end of the third plan period, it was 11 per cent and in the fourth plan period it was 15 per cent.³ The quantum of long-term credit advanced during various periods were as follows: Rs.125.3 millions upto 1951, Rs.64.1 million during

³Financial Express, December 12, 1973, p.3.

first plan period (1951-56), Rs.255.4 million during second plan period (1956-61), Rs.1594 million during third plan period (1961-66) and Rs.7910.9 million during fourth plan period (1969-74).⁴

Among the many sources of credit, for long-term, to finance farm development, co-operative land development banks have been assigned a significant role in recent times especially with funds made available through agencies such as World Bank and Agricultural Refinance Corporation, India.

At the close of the nineteenth century when indebtedness was growing among cultivators the Government set up its own machinery for meeting the long-term credit needs of cultivators from State funds, in the form of taccavi loans under the Land Improvement Loans Act of 1883. But "taccavi is apt to be little else than the ill-formed disbursement of inadequate moneys by ill suited agency".⁵

Land Development Banks in India

The evolution of long-term credit in the existing pattern has a history, which is briefly reviewed hereunder. With the introduction of the co-operative movement in 1904, when the Co-operative Credit Societies Act was passed it was felt that it would be in a position to provide both long-term

⁴Brochure on Land Development Banks (Bombay: National Co-operative Land Development Banks' Federation, 1975) p.4.

⁵The General Report, All India Rural Credit Survey, (Abridged ed.: Bombay: Reserve Bank of India, 1955) p.83.

and the short-term credit. The primary co-operatives could not undertake long-term financing because the central co-operative bank on which they depended for their finance could provide only short-term finance. The 1904 Act was revised and broadbased in 1912. In 1919 when co-operation became a State subject, different laws were passed in different States. The 'Land Mortgage Banks' later redesignated as 'Land Development Banks' were formed only at the later stage of co-operative movement in India, and in fact, were not in existence in many States when the country attained independence in 1947.

The earliest efforts in the direction of setting up of land mortgage banks were made in Punjab (1920), Madras (1925) and Bombay (1929). However, these banks did not succeed because of some difficulties in their formative stages. A real beginning could be said to have been made only in 1929 with the establishment of the Central Land Mortgage Bank in the Madras Province,⁶ at the instance of the Townsend Committee Report.⁷

During the Great Depression in the thirties, not only the lending operations came to stand still but the action of

⁶Present Tamil Nadu State formed a part of the Madras Province.

⁷Government of Madras, Report of Committee on Co-operation, Madras: Government Press, Madras, 1928), p.59.

private lenders to foreclose the mortgage and attach the lands through decrees issued by civil courts had created an explosive situation in rural areas. The need to save lands of cultivators from passing into the hands of money lenders was, therefore, keenly felt and land mortgage banks were given the task. However, during World War II when the prices of the agricultural commodities and land values were high the farmers were able to manage without having recourse to borrowing from land mortgage banks. Thus the period 1939-45 witnessed a general shrinkage in the business of land mortgage banks. Later because of the higher cost of living and higher outlays for agricultural inputs the farmers were forced to depend on the external sources of finance. Another factor which influenced the demand for long-term loans was that with the introduction of active debt relief measures in various provinces and states during the period, the private source of credit had dried up to a large extent and cultivators had to look mainly to co-operative organizations for their long-term as well as short-term credit. Moreover, the attainment of independence of the country in 1947 and the introduction of planned economic development from 1951 onwards as well as the encouragement given by the government to stimulate production of food grains made cultivators conscious of the benefits of land improvement for which they required financial assistance.

A committee of Direction appointed by the Reserve Bank of India in 1951 conducted extensive Rural Credit Survey. In pursuance of the recommendations of the said committee, emphasis was shifted from land mortgage banking to land development banking and central land development banks were organized. As on June 1973 there were central land development banks in 18 States and one Union Territory out of the total of 21 States and 9 Union Territories. The progress made by the central land development banks in financing land development is summarized in Appendix G.1 and 2.

It was also felt that the existing institutions could not provide finance for schemes of land development under the command areas of major and medium irrigation projects and schemes, especially more for plantations and horticultural crops, because of the large outlay involved or special terms such as long gestation period. These schemes required co-ordination between various departments of the Government. Government of India and the Reserve Bank of India took steps for the establishment of the Agricultural Refinance Corporation by an Act of Parliament under the Agricultural Refinance Corporation Act, 1963. The All India Rural Credit Survey Committee and the committee on Co-operative Credit also stressed that schemes of productive purposes were to be framed.⁸

⁸Report of the Committee on Co-operative Credit (Delhi: Government of India, 1960) p.164.

The setting up of the Agricultural Refinance Corporation in July 1, 1963 gave a fillip to the loaning operations of land development banks. During the period 1963-64 to 1973-74, the Agricultural Refinance Corporation had disbursed a total sum of Rs.3170 million to the various eligible institutions viz., central land development banks, commercial banks and apex co-operative banks. The financial assistance provided to land development banks formed 86 per cent of the disbursement.

International Development Association (IDA) and the International Bank for Reconstruction and Development (IBRD) reviewed in 1958 the position of agricultural credit institutions and on-farm investment requirements in selected parts of the country, in order to identify the high priority agricultural credit projects. At the end of June 1974, they sanctioned 18 projects involving a total financial assistance of Rs.2850 million to Agricultural Refinance Corporation. The participation of land development banks was envisaged in most of these projects.

Emerging Problems

As noted earlier, advancing loans on a large scale for development purposes began with the inception of the Agricultural Refinance Corporation during 1963. However, the concept of assessing the loan eligibility based on the repaying capacity and incremental income of the farmer

rather than the value of the security offered can be said to have started from the year 1968-69 when the assistance from IDA for long-term credit was made available.

Advancing loans for development purposes, against the repaying capacity and incremental income poses variegated problems. Formulating correct estimates of the loan requirement based on the technical estimates, estimating the improvements, visualized, the pay-off for the investment, underwriting, staff requirements and follow up for loan utilization are some of the problems. The loan eligibility of a farmer is based on his need and repaying capacity. Detailed studies are necessary for formulating valid guidelines. Next, the projects that realised higher pay-off for the farmers are to be identified for formulating schemes.

The quantum of credit for which a farmer is eligible is limited, and therefore, the farmer should be prudent in the management of the limited borrowed funds. The farmers can be prudent only if they are appraised of different opportunities of investments and related returns. This information is provided only by a post-development assessment of the project and analysis of costs and returns of these investments.

Capital investments bring changes in the cropping pattern and in the use of farming technology. These changes require adjustments in the farm structure. Further, to maintain the

growth, a farmer has to reinvest the savings, defined as net returns over consumption and debt repayments, generated due to development. An indication to the farmer regarding the pattern of the future growth, in his farm, for a rational development in the long run, is necessary.

The above mentioned changes, endogenous to the farms, collectively bring about an exogenous change in the rural economy mainly with reference to employment.

The land development banks in Tamil Nadu State have been financing for development purposes from the year 1968-69 onwards. Loans issued for various purposes for the five years from 1968-69 to 1972-73 are given in Appendix H 1 to 5. The loans were issued on the basis of assessed repaying capacity to be generated by the incremental income of the proposed investment. These assessments were made at the pre-development stage but post-development assessment which would indicate the real opportunity costs of this investment had not been attempted so far. This is one of the major reasons which invited attention for undertaking the present investigation.

Hypothesis✓

The financing of land development banks for farm development projects could have resulted in additional income sufficient not only to cover the debt obligations but also to provide for additional investment for the growth of the farm.

The present study is, therefore, an attempt to estimate the rate of return generated by different investments in the select farms and their growth during the loan amortization period. Further, it attempts to analyse the changes in the enterprise-mix and employment opportunities in the farms due to the development.

Objectives

The objectives of the study are set as follows:

(i) to estimate the rate of return generated in different types of projects financed by the land development bank and to identify the most profitable type of investment for the farm firms,

(ii) to study the existing enterprise-mix and to determine the optimum enterprise-mix in the pre-development and post-development situations, and

(iii) to determine the desired course for growth of the farm during the loan amortization period.

Design of the study

The study is based on the primary data collected by field survey in Kancheepuram taluk of Chingleput district, Tamil Nadu State. Out of 15 districts in the State, Chingleput district was selected at random. Out of the eight taluks in the district Kancheepuram taluk was selected by random sampling. In Kancheepuram taluk there are three primary land development banks

viz., Kancheepuram, Uthiramerur and Walajabad, covering the three community development blocks in the taluk. The study covers all the beneficiaries of the three primary land development banks to whom loans were issued during the period from 1968-69 to 1972-73. From the universe, 200 sample farms at the rate of 100 for minor irrigation, 50 for farm mechanization and 50 for land reclamation were selected by random sampling for detailed study. For the purpose of analysis and interpretation of results, the sample was post-stratified into small, medium and large size groups.

Capital budgeting technique, using the Internal Rate of Return method (IRR), was employed for appraising different types of investments in the farm. The normative crop-mix before and after the development were estimated by using the linear programming technique. The desired courses of growth of the farm firm for reinvestments of the savings in the farms were estimated by building up a multiperiod linear programming model. Other statistical tools were also employed wherever necessary.

Scope of the study

The present study attempts to analyse the likely changes generated by development finance provided by land development banks in Tamil Nadu. The concepts of long-term credit and growth of farm firms and the institutional frame work which facilitates development finance were studied. The study also attempts to specify a model to explain changes over time and

examines the tool of analysis relevant for empirical estimation. However, the models adopted in the study are deterministic models and in real situation a large number of stochastic elements influence the decision. The results of the study should be viewed with this limitation in mind.

It may be added that the study involving the analysis of cross sectional data, prices are assumed to be constant at farm gates and that the differences in prices of various products in different centres are mainly due to differences in the cost of transport of commodities over space and time. The conclusion of the present study relate to the general situation as obtaining in the Chingleput district.

The conclusion of the study further provide much needed information on the various aspects of long-term finance, that of the land development bank and its influence on farm growth. For the policy maker the study will, apart from other things, bring out the shortcomings in the existing system of long-term credit and, thus, help him to formulate meaningful policies for project design and choice and for obtaining specified rate of growth.

On the methodological issues the present study demonstrates the uses of capital budgeting technique in the choice of investment alternatives in the farms. The study also examines the effective use of linear programming and multiperiod

linear programming techniques in determination of optimum crop-mix and the desired growth pattern for the farms under varied resource restrictions.

It must be stated that there exists some data problem, in as much as the present study is based on the 'Survey method' and the data were collected through questionnaires. Ideally cost accounting procedure would be more suited but due to the limitations, in terms of time and finance at the disposal of the present investigator, this could not be adopted.

Structure of the thesis

The thesis is partitioned into six chapters as follows:

In Chapter I, the need for long-term credit for increasing the production in agriculture and for farm development, the history and development of long-term credit in India, the need for the present study, hypothesis, objectives, design and the scope of the study are explained.

In Chapter II, the development of the concepts on capital budgeting and multiperiod programming are discussed with reference to works of various authors and research workers on the subject. The studies conducted on the impact of investments in the farms, cost-benefit studies of farm investments and factors responsible for the growth of the farm firm are also reviewed.

Chapter III deals with the design of the study with respect to sampling and tools and models used for the analysis. The sampling procedure adopted for the present study is amply discussed.

A brief agro-climatic sketch of Kancheepuram taluk, where the study was conducted, is presented in Chapter IV. Rural infrastructure of the area is also explained in detail to enable the reader to conceive the results in its rural perspective.

In Chapter V, the results of the research work conducted are presented. The results are interpreted, discussed and broad conclusions are drawn. The general features of the sample farms, quantum of finance for various purposes, comparison of pre, and post-development situations of the farms bring out the impact of the projects, optimum plans for maximizing the farm income and the results of the multiperiod programming analysis are presented.

Chapter VI presents the summary and conclusions of the study with discussions on their policy implications.

CHAPTER II

CONCEPTS AND REVIEW

The major objective of the study is to analyse the likely changes generated by development finance provided by land development banks in Tamil Nadu. The concepts of long-term credit, and growth of farm firm, the institutional frame work which facilitates development finance, specification of appropriate model to explain changes over time and tools of analysis relevant for empirical estimation of changes are relevant. In the present Chapter a brief review of earlier works are attempted and the choice of literature has necessarily to be restricted to a few selected works due to space limitations.

A. Review of Studies on Agricultural Finance

Most of the studies on agricultural finance, conducted between the year 1941 and 1947, focussed on problems of rural credit, money lending legislations, lending policies and rural indebtedness.¹

A comprehensive and systematic survey covering 600 villages

¹For example, (i) P.N.Driver, "Problems of Rural Credit", Ind. J. Agrl. Econ., 2:89, August 1974, (ii) D.K.Iyengar, "Long-term Agricultural Finance with Special Reference to Land Mortgage Banks", Rural India, 6:280-85, 1943, (iii) S.S.Santhanam, "Money Lending Legislation and Rural Credit", Ind. J. Agrl. Econ., Conference Number, April 1947, and (iv) K.G.Siwaswamy, "Problems of Rural Credit", Ind. J. Agrl. Econ., 2:113, 1947.

in 75 districts spread throughout the country was conducted by the Reserve Bank of India and the study is entitled All India Rural Credit Survey (1954). Chingleput district of Tamil Nadu State, the district selected for the present study, was also covered by the study. The study revealed a woeful lack of credit in the rural areas for farm development and that co-operative credit movement by its own unaided efforts would not be able to meet the credit requirements of farmers.² The study also pointed out serious bias against small and medium farmers because of security oriented lending policy and limitations in the structure of co-operative credit.³ As a remedy it suggested that (i) rural credit should be based on expected incremental income rather than security, (ii) it must meet the long, medium and short-term needs, (iii) it must be supervised and (iv) it must be made available to all those who are credit worthy and at a moderate rate of interest.⁴

i) Co-operative credit institutions

The importance of agricultural credit through co-operative institutions and needed changes for realising desired improvements

²Reserve Bank of India, Rural Credit Survey (Bombay: Reserve Bank of India, 1954), pp 326-8.

³Ibid., p.431.

⁴Ibid., p.450-467.

in farming were studied by the following workers. Akad pointed out that land mortgage banking in India is an important agency for financing land improvements and agricultural development.⁵ Ram also came to the conclusion that the best lending agency against farm mortgages is the land development bank.⁶ According to him such financing requires a large and continuous flow of funds for purchase of additional land as well as for developing the already existing land resources. Further as the farm mortgage is for the long-term investment it should take into account the borrowers' and as well as lenders' interest.⁷

Bose observed that both agricultural credit in general and co-operative credit in particular are admittedly inadequate for getting the best results in terms of productivity. He therefore, suggested that credit plans have to be closely related to and based upon production plans.⁸ Mahabal emphasised that supervision-financial and technical, provision of other services by extension machinery, proper working out of costs and detailed planning of the new projects are all necessary to ensure that the finance provided by credit agencies was not

⁵C.B.Akad, "Land Mortgage Banking in India", Ind. J. Agrl. Econ., 15:72, 1957.

⁶K.V.Ram, "Farm Mortgages and Cooperative Finance", Ind. J. Agrl. Econ., 15:16, Jan.-March, 1957.

⁷Ibid., pp. 17-20.

⁸S.K.Bose, "Co-operative Credit and Agricultural Productivity in India", Ind. J. Agrl. Econ., 16:224, Jan.-March, 1961.

misdirected and also that it pays its way in the long run.⁹ Johl and Singh conducted a research study in Punjab and found out that Government and co-operative institutions were not meeting the full requirements of development finance in the farms.¹⁰ Deoras also found that the credit available through co-operatives for current agricultural production as well as for land development has not been adequate or well distributed in the different States.¹¹

The credit needs of the farmers were studied by Bhargava and Shah. They conducted a pilot study with the objectives of (i) finding out the net worth and repaying capacity and (ii) to find out the credit needs of small, medium and large sized farmers. According to the study the small farmers give highest priority for loans for purchase of pumpsets which increases their repaying capacity. The medium sized farmers need credit for expenses on fertilizer, hired labour, tube well, tractor, agricultural implements and buildings. In the case of large farmers, credit is required to cover the labour expenses, cost of fertilizer and investments in tube wells,

⁹S.B.Mahabal, "Agricultural Development and Co-operative Finance", Ind. J. Agrl. Econ., 18:182, Jan.-March, 1963.

¹⁰S.S.Johl and B.P.Singh, "An Evaluation of Agricultural and Co-operative Credit in Punjab", Ind. Co-op. Review 3:850, 1965.

¹¹D.R.Deoras, "Institutional Finance for Agricultural Development". Ind. J. Agrl. Econ., 23:36, Dec. 1968.

tractor and buildings in that order.¹²

ii) Utilization of Co-operative Credit and its Impact

The aspect of utilization and impact of agricultural credit was studied by a number of workers. A few of these studies and the findings are discussed below.

Kahlon and Gurminder Singh after studying the role of co-operative finance for agricultural development came to the conclusion that co-operative loans were mostly advanced for production purposes. However, a part of these loans were used for unproductive purposes.¹³ Singh studied agricultural development vis a vis long-term co-operative finance in Gujarat State. The study clearly revealed that the co-operative finance had made a significant contribution to the capital formation in the farms and consequently, helped in raising their productivity.¹⁴

Mitra and Pati observed from a case study of an

¹²V.K.Bhargava and S.L.Shah, "Credit Needs of a Changing Agriculture - a Potential Area for Commercial Bank Finance", Ind. J. Agrl. Econ., 23:38, Oct.-Dec., 1968.

¹³A.S.Kahlon and Gurminder Singh, "The Role of Cooperative Finance in Agricultural Development", Ind. Co-op. Review 1:41, 1963.

¹⁴Udayaban Singh, "Agricultural Development and Long-Term Finance", Ind. J. Agrl. Econ., 18:193, Jan.-March, 1963.

agricultural credit society that a large number of the members had no development plans because of the limited scope for improvement of physical assets, small and fragmented holding, lack of knowledge of alternative possibilities for development and of spirit of enterprise and low risk bearing capacity.¹⁵

Srinivasan and Rajagopalan studied the working of nine co-operative institutions of different types and concluded that it was difficult to find close association between co-operative finance provided and the development of agriculture reported probably because of various imponderables involved in lending policies and practices of co-operative institutions.¹⁶

Rajagopalan studied the farm liquidity and institutional finance for agricultural development and attempted to evaluate the significance of assets vs. liquidity as a norm for financing. He pointed out that inter-sectoral imbalances in capital availability and supply retards the growth in agriculture which in turn inhibits economic development. If agriculture should rise, its need for capital should be satisfied by inter-sectoral capital mobility. To achieve this, the investment risks in agriculture should be minimized through

¹⁵A.K.Mitra and L.K.Pati, "A Case Study of the Working of an Agricultural Co-operative Credit Society", Ind. J. Agrl. Econ., 18:209, Jan.-March, 1963.

¹⁶M.Srinivasan and V.Rajagopalan, "Agricultural Development and Co-operative Finance", Ind. J. Agrl. Econ., 18:217, Jan.-March, 1963.

measures such as crop insurance which will ensure sustained flow of capital into and off agriculture for an overall inter-sectoral balance and development.¹⁷

From the foregoing studies it is evident that land development bank plays an important role in advancing long-term credit to agriculture. There is a great demand for credit as compared to its availability for investing in various projects in farm business. However proper planning is necessary to ensure efficient allocation of available credit among competing projects.

B. Investment Decisions and Project Appraisal

In order to evaluate the returns for the various farm investments, capital budgeting, using the internal rate of return criteria, has been adopted in this study. As such a brief review of the work on capital budgeting regarding the concepts, methodological issues and results thereof is presented below.

Masse has observed that the act of investing constitutes the sacrifice of an immediate and certain satisfaction in exchange for a future expectation whose security lies in the capital invested.¹⁸

¹⁷V.Rajagopalan, "Farm Liquidity and Institutional Financing for Agricultural Development", Ind. J. Agrl. Econ. 23:25-29, Oct.-Dec., 1968.

¹⁸Pierre Masse, Optimal Investment Decisions (New York: Prentice Hall, 1962) p.2..

An investor faces a problem in deciding the lines of investment when the choice of alternatives are many. According to Wright the decision on the commitment of funds to long-term uses within the business are among the most critical for its continued success and also most difficult to make. Such decisions are critical because they deal with large funds over periods and there is a little chance for reversing the decisions once made and put into effect.¹⁹

With the development of management science and techniques there are many tools available to analyse the investment opportunities and investment decisions. Capital budgeting is a technique which helps investors in decision making. According to Baumol capital budgeting refers to the investment decision making procedures of business firms and other enterprises.²⁰ Philippatos has observed that capital budgeting is concerned with the allocation of the firm's scarce resources among the available market opportunities,²¹ Thus the capital budgeting technique seeks to evaluate different projects on which investments are made on the basis of their capacity to earn an attractive return on investments.

¹⁹M.G.Wright, Financial Management (London:McGraw Hill, 1970), p. 58.

²⁰William J. Baumol, Economic Theory and Operations Analysis, (New Delhi: Prentice Hall of India Private Ltd., 1973), p.19.

²¹George, C. Philippatos, Financial Management-Theory and Techniques (Sanfrancisco: Holden-Day, Inc., 1973), p.66.

Javadekar delineates two objectives of project analysis namely (i) social or economic analysis and (ii) financial analysis. The social or economic analysis considers the total return or profitability to the whole society or the economy of all the resources committed to the projects, regardless of who in the society contributes to them and who receives the benefits. On the other hand, the financial analysis is concerned with the individual financial entities which participate in a project. It is concerned about the return to the equity capital which an individual contributes.²²

The present study was concerned with individual farmers and how their choice affects their returns and therefore preferred the financial analysis approach.

In financial analysis, the projects and choice making are two aspects to be considered. A project is an activity where money is spent in expectation of returns and which logically is concerned with planning, financing and implementation as a unit.²³ In agriculture an investment activity can be one where capital resources are expended to create an asset from which benefits are expected to be realised over an extended period of time.

²²M.S.Javadekar, Capital Investment Appraisal of Agricultural Projects, (Poona: College of Agricultural Banking, Reserve Bank of India Brochure, 1974), p.6.

²³Ibid., p.8.

The choice between two investment implies, in economic terms, a choice between two schedules of returns. Lutz and Lutz studied the entire investment process from the time a project is launched to the time its products are consumed. They identified three distinct patterns of investment and return relationships viz., (i) point-input and point-output, (ii) continuous-input and point-output and (iii) point-input and continuous-output. The investment made out of land development bank finance in farms are mostly of point-input and continuous-output pattern.²⁴

According to Hague, point-input and continuous-output involves capital outlays i.e., investing funds in the present in the hope of obtaining profit from them in the future. In such investments, sums of money spent and received cannot be taken at their face values, since the worth of money is subject to changes over periods. The stream of future earnings - net cash flow which is acquired, when any capital asset is bought, has a quantity dimension (money value) and time dimension. When any investment decision is taken the time profile of the net cash flow must be taken into account.²⁵

²⁴F.A.Lutz and Vera Lutz, Theory of the Investment by the firms (Princeton: Princeton University Press, 1951).

²⁵D.C.Hague, Marginal Economics (London: The English Language Book Society and Longman Group Ltd., 1971), p.315.

Under such conditions and faced by allocation problems which grow in size and complexity it is natural that the decision makers express an increasing interest in formal methods of investment evaluation. Schwab has stated that in designing any formal method of investment evaluation the central problem is the choice of proper criterion for making the economic desirability of investments.²⁶

A number of different criteria have been proposed in the literature and are being used in practice. While these alternative criteria are often based on similar concepts, they are different enough to yield contradictory results in a number of situations and a number of authors have discussed their merits and demerits.²⁷ However, the present review is limited to a set of criteria discussed below.

²⁶ Bernard Schwab, "Current Limitations and possible Extensions of some common criteria for Investment Evaluation" in Cost-Benefit Analysis. Ed. M.G.Kendall, (London:English University Press Ltd., 1971), pp.305-313.

²⁷ For example (i) F.A.Lutz and Vera Lutz, op.cit.,

(ii) Herald Biermans Jr. and Seymour Smidt, Economic Analysis and Financing of Investment Projects (2nd ed. New York: The Macmillon Company, 1966) p.420 and Capital Investment Decisions (London: Macmillon Company, 1963).

(iii) C.S.Page and E.E.Canaway, Finance for Management (London: Heinemann, 1966),

(iv) M.G.Wright, op.cit.,

(v) W.J.Baumol., op.cit.,

(vi) G.C.Philippatos, op.cit., and

(vii) M.S.Javadekar, op.cit.,

i) Benefit-cost Ratio

In the words of Schwab benefit-cost ratios are probably the most widely used criteria for evaluating investments. It is a profitability index and is simply the ratio of the present value of cash inflows and outflows. There are two types of ratios - aggregate ratio and the netted ratio, which are presently in use.²⁸ The most commonly used form of benefit-cost ratio compares discounted gross or total benefits with discounted gross or total costs. In comparing one project with the another, in which the same pattern of netting out can be used, the benefit-cost ratio is used almost exclusively as a measure of social benefit i.e., for economic analysis. Its use for private investment or financial analysis is extremely limited.²⁹

Sovani and Rath estimated the economic benefits, primary direct and secondary direct, of a multipurpose river dam viz., Hirakud Dam. According to their study the primary direct benefit-cost ratio of irrigation is 2.4 and the secondary direct benefit-cost of irrigation is 2.26. The employment opportunities in the area increased from 88 per cent to 94 per cent.³⁰

²⁸ Bernard Schwab, op.cit., p. 305-313.

²⁹ M.S. Javadekar, op.cit., p.10.

³⁰ N.V. Sovani and Nilakanth Rath, Economics of a Multipurpose Dam (Bombay: Asia Publishing House, 1960) pp.230-245.

Likewise, Basu and Mukherjee evaluated the direct and indirect benefits of irrigation in the command area of the Damodar canals and found that the average yield of crops increased from 150 kg to 250 kg. The employment opportunities increased from 128 to 162 mandays. The benefit-cost ratio was 1:1.934.³¹

ii) Pay-Back Period

Bierman and Smidt have defined pay-back period as the length of time required for the stream of cash proceeds produced by an investment to equal the original cash outlay of the investment.³² Though this method is simple to use, Philippatos,³³ Javadekar³⁴ and others have considered that the pay-back method leads to wrong decisions since it leaves out from consideration the cash flows accruing after the pay-back period but during the life of the project. It will also be not consistent with intuitive ideas since projects with shorter pay-back periods could be less profitable than those with longer pay-back periods.

³¹ S.K. Basu and S.B. Mukherjee, Evaluation of Damodar Canals (1959-60) - A study of the Benefits of Irrigation in Damodar Region (Bombay: Asia Publishing House, 1963), pp.138-142.

³² Harold Bierman Jr. and Saymon Smidt, op.cit., p.18-20.

³³ George C. Philippatos, op.cit., pp.73.

³⁴ M.S. Javadekar, op.cit., p.12.

However, Dougall³⁵ and Meridith³⁶ have favoured this method for certain types of business concerns. According to Quirin this method is popular even among Soviet planners.³⁷

iii) Average Profit on Average investment

Javadekar has stated that the average investment involves the relating of the average saving or increased income after depreciation to the average investment.³⁸ This method is also called as 'accounting rate of return', or 'average rate of return' or simply the 'rate of return'.

Philippatos has identified three versions of this method (i) original book method where the rate of return from a given project is computed ex post, by dividing the average annual net income, defined as cash flows minus depreciation charges by the original book value (cost) of the asset, (ii) average book method is computed by dividing average annual net income by the average book value. The average book value is computed by subtracting the expected salvage value from the original cost and dividing by two and (iii) in year by year book method the rate of

³⁵H.E.Dougall, "Pay-back as an Aid in Capital Budgeting", The Controller, 29:No.2, 1961.

³⁶G.G.Meridith, Capital Investment Decisions (New York: Harper and Row, 1969).

³⁷David G.Quirin, "The Capital Expenditure Decision" (Home Wood Ill.:Richard D.Irwin Inc., 1967).

³⁸M.S.Javadekar, op. cit., pp.12-15.

return is calculated for each year on the basis of original book method.³⁹

The basic concept behind the calculation of rate return is inherent in the question: at what interest rate would the same amount of capital have to be invested in order to produce the same total income over the life of the project? Because of this, the method is also called as Plough-Back criteria.

The average rate of return method understates the true rate of return. It may have inconsistent rankings of mutually exclusive investments.

The basic defects in pay-back and average rate of return methods have been discussed by a number of authors. Hague has stated that these traditional methods fail to allow for differences in the timing of the payments and the receipts associated with an investment project. In these methods, amounts invested and returns on them, are taken at their face value whatever the dates on which they are received.⁴⁰ This view is supported by Baumol⁴¹ and others.

It is, therefore, necessary to look for a concept derived from economic principles, as against accounting ones,

³⁹George C.Philippatos, op.cit., p.73-78.

⁴⁰D.C.Hague, op.cit., p.315.

⁴¹William J.Baumol, op.cit., pp.462-463.

which are generally much more satisfactory for evaluating capital investment project. This had led the economists to adopt the concept of 'Present value' (PI). In the words of Philippatos, the concept of present value, which comes to grips with the problem of futurity is common foundation of the various techniques.⁴² It involves the equivalence and inter-changeability of two sums of money at different points of time. Accepting this concept the following three methods are widely adopted for evaluating the investments in the projects. They may be discussed as under.

iv) Net Present Value (NPV)

Net present value concept is based on the principle of 'time value of money'. The NPV of an investment is a measure of the absolute profits of that investment and is defined as the difference between the present value of inflows and the present value of the outflows of the investment, both discounted at the cost of the capital i.e., the rate of interest.

This method presupposes the existence of a perfect capital market. The main problem here is as to which 'discount rate' to be used. Some argue that market rate of interest is to be used. Others advocate use of the opportunity cost rate of return.

⁴²George C. Philippatos, op.cit., pp.78-79.

Hirshleifer has suggested an alternate criterion called 'Net Terminal Value' for making capital budgeting decisions.⁴³ According to this the cash flows and outflows are compounded forward to some future terminal date. It is converse of discounting the same flows to their present value. The rule for 'accept or reject decisions' is that a project should be accepted if its net terminal value, defined as the difference between the compounded benefits and costs, is greater than zero. It is obvious that there is a complete parallel between the compounded net terminal value and the discounted net present value.

v) Internal Rate of Return (IRR)

This criterion expresses the estimated value of a project as a single overall rate of return per annum. The rate of return in this case is equal to the rate of interest (discount) at which the present value of expected outlays and cash earnings are exactly equal.

vi) Profitability index (PI)

It is also called as Discounted Benefit-Cost Ratios (DCBR). Schwab has described the DCBR as the ratio of the present value of future benefits at a given discount rate, over the present value of the outlays discounted at the same rate.⁴⁴

⁴³Jack Hirshleifer, Investment, Interest and Capital (Engle wood Cliffer, NJ: Prentice Hall, Inc., 1970).

⁴⁴Bernard Schwab, op.cit., pp.305-313.

Qurin has suggested a modified method which converts discounted annual costs into equivalent average annual outlays that are, in turn, compared to the average annual returns.⁴⁵ The comparison of the average discounted inflows and outlays determines the desirability of the investment proposal. The rule for accepting or rejecting a project is that a project should be accepted if the gross ratio of the annual benefits over the annual costs is greater than one. This method, known as Annual Benefit-cost Ratio gives exactly identical answers with the discounted benefit-cost ratio when salvage value is included.

vii) The Net-Costs Criterion

Messe has suggested the Net Costs Criterion for capital budgeting.⁴⁶ This method involves the minimization of average cost reduced to present values, of the entire productive activity of the firm; present and future. It relates directly the cycle of product demand to production and investment demand. However, this technique becomes complicated by the problem of cost implications in joint-product manufacturing and by the problem of depreciation.

⁴⁵David G. Qurin, op.cit., p.59.

⁴⁶Piere Masse, op.cit., pp.12-23.

viii) Case studies

All the techniques narrated above have assumed complete certainty and decision is based on full knowledge about product demand, production, factor costs and other relevant variables. As these conditions are rarely found in practical decision environ several other techniques have been devised alternatively to handle problems of risks and uncertainty.⁴⁷ These mathematical models are widely used for investment decisions in industry where the market conditions and production process differ widely from that of agriculture. The pattern and degree of risk involved in agriculture require more complicated techniques. In underdeveloped countries these techniques are hardly applied with perfection due to paucity of information and facilities.

The present study, therefore, considers the evaluation of investments under the assumed conditions of certainty. Earlier, mention was made that NPV, IRR and PI are the criteria that are widely used in the capital budgeting studies. The problem and the related issues were discussed in detail in the Annual Conference of the Indian Society of Agricultural Economics at Hyderabad, in 1973. In what follows a few significant reports are reviewed.⁴⁸ A majority of the studies

⁴⁷Mathematical programming models developed by Markowitz (1959) Portfolio models developed by Roy (1952). Simulation models used by Saddi (1971) and game theoretic models are a few to cite in this regard.

⁴⁸See Conference Number of the Indian Journal of Agricultural Economics Vol.28, No.4 Oct-Dec., 1974.

concentrated on the evaluation of minor irrigation projects; a few of them dealt with irrigation machinery, soil conservation and land reclamation projects, rural electrification and other special projects.

George and Joseph evaluated investments in tree crops by adopting various criteria including IRR and came to the conclusion that oil palms, among the three tree crops considered, provided more favourable returns to capital with shorter pay-back period.⁴⁹

Mukhopadhyay made a comparative economic evaluation of deep tube well and shallow tube well as alternative device of irrigation in Nadia district of West Bengal.⁵⁰ The comparative economic analysis was attempted on the basis of three alternative discounted measures, viz., benefit-cost ratio, net present worth and internal rate of economic return. His study revealed that shallow tube wells would be preferred because of their higher rate of returns than the deep tube wells even though per unit capital investment and operation and maintenance costs per acre of the deep tube wells were less.

⁴⁹M.V.George and P.T.Joseph, Ibid., pp.173-80.

⁵⁰A.Mukhopadhyay, Ibid., pp.189-96.

Sain and Kundu analysed the benefits and costs, in particular direct and tangible ones, of three bank financed electrically operated shallow tube wells installed in an area in West Bengal.⁵¹ Gross annual benefits and costs, value of total discounted returns and total compounded costs of the venture were calculated by using the amortization formula and on the current rate of interest. Both the ratio of annual gross benefits and costs and net overall benefits per unit of investment for the full useful life of the shallow tube wells were found to be high.

Singh and Singh worked out the benefit-cost ratio of four categories of State tube wells installed under different plans in Uttar Pradesh.⁵² He found that, at the existing running level, the economic feasibility of tube wells was very poor except for tube wells installed during the first Five-Year Plan, the reason being partly the increased cost of installation and partly due to under utilization of tube wells.

Srivastava made a study in Kalyanpur block of Kanpur district to determine the investment and operating cost of private tube well unit and to work out the benefit-cost relationship on different size of farms.⁵³ The results

⁵¹K.Sain and S.N.Kundu, Ibid., p.231.

⁵²Lakshman Singh and R.P.Singh, Ibid., pp.231-232.

⁵³H.L.Srivastava, Ibid., p.232.

indicated that an additional input of 111.18 per cent on the tube well irrigated farm resulted in an additional output of 153.19 per cent and net income of 228.06 per cent over the non tube well irrigated areas.⁵⁴

Chawla et al. conducted a study in Amritsar district (i) to determine the extent of utilization of loans financed by the different banks under the Small Farmers' Development Agency schemes, (ii) to examine the improvement effected in cultivation as a consequence of irrigation by tube well and (iii) to work out the cost-benefit ratio. They noted significant shifts in the cropping intensity, cropping pattern, yield rates of crops and net income as a result of tube well irrigation. The cost-benefit ratio worked out to 1:1.74 showing the feasibility of the installation of tube wells.⁵⁵

Bhati et al. made a benefit-cost analysis of irrigation projects in Badur district of Uttar Pradesh and found that one rupee invested in tube well irrigation added to Rs.3.11 to net returns, and thus concluded that there existed a good prospect for converting unirrigated areas into irrigated areas through tube wells in that district.⁵⁶

⁵⁴Ibid., p.232.

⁵⁵J.S.Chawla, S.S.Gill and M.S.Dhariwal, Ibid., p.233.

⁵⁶J.P.Bhati, R.N. Tewari and L.R.Singh, Ibid., pp.234-5.

Moorthy et al. studied the cost-benefit of irrigation on high yielding variety of wheat in a region in Uttar Pradesh and found out that the benefits from the investments in irrigation could be greatly influenced by the resource use and its allocation in the farms.⁵⁷

Shukla conducted a study to evaluate the profitability of irrigation from surface wells either through electric or diesel pumps. He concluded that irrigation combined with advanced technology had great impact on the farm incomes.⁵⁸

Gupta et al. made an economic analysis of soil conservation measures in Varanasi district using the benefit cost technique to determine whether the investment on the project had contributed significantly to the development of economy as a whole. They have found out that the value of direct benefits obtained from the soil conservation measures during the study year exceeded the annual cost of the project by 358 per cent.⁵⁹

Patil estimated the primary benefits and costs of soil and water conservation projects in a taluk in Poona

⁵⁷T.V.Moorthy, Banarsi Lal and K.K.Verma, Ibid., p.241.

⁵⁸V.P.Shukla, Ibid., p.235.

⁵⁹S.B.Lal Gupta, R.Prasad and R.K.Panday, Ibid., pp. 205-230.

district of Maharashtra State. According to him the benefit-cost ratio of the project worked out to 1.84.⁶⁰

Sisodia reported from a study of the cost and returns from irrigation and land development in command area of Tawa Project in Madhya Pradesh that investment in irrigation and land development had favourable rate of return which worked out to Rs.4.90 for every rupee invested.⁶¹

From the studies reviewed so far it is evident that a number of workers have evaluated the projects employing different techniques. The merits and demerits of these techniques are discussed in the succeeding part.

Mukhopadhyay has discussed the merits and demerits of the various criteria. He has stated that the PI and NPV measures rest on the assumption of a particular discount rate representing the opportunity cost of capital. If the opportunity cost of capital turns out to be different from the assumed rate, the selection of projects on the basis of the above two criteria may prove to be disastrous.⁶² The

⁶⁰S.M.Patil, Ibid., p.242.

⁶¹T.S.Sisodia, Ibid., p.242.

⁶²A.Mukhopadhyay, op.cit. p.195.

relative merit of the IRR is that it does not rest on any assumption regarding the opportunity cost of capital. Further he observed that the PI criterion unduly discriminates in favour of the projects with low value of the ratio of the annual operation and maintenance cost to the initial investment. In other words, it discriminates projects where most of the cost is on initial investment and the year-by-year expenses are minimal. As compared to PI and NPV criteria, the relative merit of IRR rests in that it does not depend on any assumption regarding the opportunity cost of capital. Further, IRR is a good indicator of the profitability of a project to the farmer because the farmer can compare this IRR with returns in other projects. It provides the basis for ranking projects in a more realistic way because it measures returns to the 'multi-input' on the farm.⁶³

The IRR criterion can thus reflect the opportunity costs correctly.⁶⁴

Rajagopalan et al. have evaluated an agricultural project under different criteria and established that IRR is comparatively a good measure to be adopted for capital budgeting.⁶⁵ Conceptually, therefore, one would consider

⁶³Ibid., pp.194-196.

⁶⁴Edward C. Townsend, Investment and Uncertainty (Edinburgh: Oliver and Boyd, 1969)

⁶⁵V. Rajagopalan, S. Krishnamoorthy and S.A. Radhakrishnan, "Formulation, Evaluation and Financing of a Project for Agricultural Development", Ind. J. Agril. Econ., 24:479-489.

the IRR as the marginal efficiency of investment and favour its use in evaluating agricultural projects.⁶⁶

In the present study, therefore, the IRR criterion has been adopted to evaluate the different types of investments made in the farms and which were financed by the land development bank.

C. Growth of the Farm Firm

The phenomenon of growth, though defined in measurable terms, requires a set of tangible and intangible forces making for change. The former are usually the material forces of production and the latter consists of the environment causing and facilitating such a change. These two forces mutually act and react in such a manner that the process becomes cumulative. Thus growth is a multi-dimensional one.

i) Determinants of growth

Husain distinguished the factors of growth as economic and non-economic.⁶⁷ He has grouped technological changes, biological and cultural determinants, motivation, structure of production, social structure, the structure of personality, role of institutions etc., under non-economic factors; the existence and use of natural resources, labour force, savings, capital formation and the like under economic factors.

⁶⁶Ibid., p. 488.

⁶⁷Ishrat Z. Husain, Economic Factors in Economic Growth (Bombay: Allied Publishers Private Ltd., 1967), Ch.4.

Galenson and Leibenstein have showed that different investment projects have different impacts on future investment, because the productivity of each is associated with a different propensity to save.⁶⁸ This leads to the differential growth rates among the farms. Batterham has also suggested that the investments and financial decision-making affects the farm firm growth. Proper and suitable selection of projects and activities will influence the growth.⁶⁹

Sadan discussed the factors determining the pace of growth of the Israeli Co-operative farms.⁷⁰ He states that the annual growth rate of the gross product can be attributed to capital, land, labour and extended utilization of raw materials and technical progress. He has also examined the magnitude of contribution by different factors to farm growth. His examination revealed that a considerable portion of the growth is associated with capital formation. Studying the economic growth of the different types of dairy farms Fansett identified the labour use and capital managed in the dairy farms as causes of growth.⁷¹

⁶⁸W.Galenson and H.Leibenstein, "Investment Criteria Productivity and Economic Development", Quarterly J.Econ.,3: 343-370, 1955.

⁶⁹Robert Lester Batterham, "Investment and Financial Management in Farm Firm Growth", Ph.D.Thesis, Univ. of Illinois, Dissertation Abstract:32:5968-A.

⁷⁰Ezra Sadan, "Capital Formation and Growth in the Israeli Co-operative Farms", Am.J.Agrl. Econ., 50:975-990, Nov. 1968.

⁷¹Marvin R.Fansett, "An Empirical Study of the Economic Growth and Capital Formation on Selected Missouri Dairy Farms", Ph.D.Thesis, Dissertation Abstract:33:9, March, 1973.

Ghosal emphasized technology as the prime factor for growth of the farm. Output per unit of land increases as capital intensive higher technologies are used. The technology also enables one to use more capital assets in the farms.⁷² Likewise, Malhotra and Minocha emphasized that sustained economic growth requires the adoption of production techniques and production functions involving higher capital-labour ratios that yield greater and greater output per man.⁷³ They are of the opinion that shortage of capital constricts changes in techniques and organization and may lead to many opportunities going unexploited.⁷⁴ Halter observed that growth depends upon the amount of funds used for expansion.⁷⁵

In the developing economies shortage of capital is the major factor inhibiting the growth of the farms. Institutional credit is being made available to the farmers so that it may act as a leverage for growth. The importance of credit and its impact has been brought out by a number of studies.

⁷²S.N.Ghosal, Agricultural Financing in India with Special Reference to Land Mortgage Banks (Bombay: Asia Publishing House, 1966) p. 199.

⁷³P.C.Malhotra and A.C.Minocha, Studies in Capital Formation, Savings and Investment in a Developing Economy (Bombay: Somaiya Publications, Pvt. Ltd., 1971), p.252.

⁷⁴Ibid., p.254.

⁷⁵A.N. Halter, "Models of Firm Growth", J.Farm. Econ, 48: 1503-1509, 1966.

According to Elase, agricultural credit is a powerful economic force for development if used to inject appropriate capital inputs into agriculture that are not otherwise available to the farmers from their own financial, physical and labour resources.⁷⁶ Zuberi while analysing the development of various financial institutions in both the industrial and agricultural sectors has also found that the impact of institutional credit in the growth of those sectors is great.⁷⁷

Though credit is a powerful economic force, product management is necessary so that it yields better results. Baker and Hopkin have stated that capital management affects the rate of firm growth.⁷⁸ If income from capital accumulation is diverted to consumption purposes, a farmer's growth rate will be affected so as to jeopardize his ability to survive in the dynamics of a capital using agriculture.

ii) Estimation of farm firm growth

The growth rate of the farm firm was estimated in a number of works reported. However the models adopted by them differed due to data structure and nature of problems.

⁷⁶Melvin G. Elase, Institutions in Agricultural Development (Ames: The Iowa State University Press, 1971).

⁷⁷H.A.Zuberi, "Institutional Financing and Balanced Growth: An Empirical Study of Pakistan", Ph.D.Thesis, Dissertation Abstract.32:4221-A, 1972.

⁷⁸C.B.Baker and John A.Hopkin, "Concepts of Finance Capital for a capital using Agriculture", Am.J.Agric.Econ., 51:1055-1064, 1969.

Halter presented a simple model of capital accumulation and showed how growth rates are an integral part of capital accumulation process.⁷⁹ He has used functional models and explained that growth is a function of expansion costs. Growth is influenced by the funds available and used for expansion.⁸⁰ The use of funds is conditioned by the opportunity cost of investment in different sources and cost of acquisition of credit from the external sources.

Sadan employed Cobb-Douglas production function as a tool for estimation.⁸¹ He estimated the growth of the farm firm as the gross farm output as influenced by technology, capital, labour and land endowments in the farm and the magnitude of current expenditure on raw materials.

Ghosal formulated a model based on the use of land-saving coefficient.⁸² He assumed that the increase in output is proportional to the increase in the land saved. Output per unit of land increases as capital intensive higher technologies are used. For the same production less and less lands are employed as growth takes place in the farm firm.

⁷⁹A.N.Halter, op.cit., pp.503-508.

⁸⁰Ibid., pp.503-505.

⁸¹Ezra Sadan, op.cit., pp.976-977.

⁸²S.N.Ghosal, op.cit., ch.1.

Baker formulated a simple model specifying the relation of credit use to growth rates. He conceives the growth of a firm as an increment in equity, the owner's net claim on assets of the firm. His study showed that if the rate earned on assets exceeds the rate paid on debt the rate of growth is increased.⁸³

iv) Multiperiod linear programming

A multiperiod linear programming model is developed in this study to examine the impact of capital investment in the farms over time. The model also examines the optimum production behaviour of the farm firm during the amortization period of the land development bank loan amount. In what follows a brief review of work done in this field of research is presented.

Linear programming technique was first applied by Dantzig and his co-workers, to minimise time and cost in moving men and supplies during the Second World War. Later, Koopmans and a number of economists developed linear programming as a flexible and powerful tool of

⁸³C.B.Baker, Role of credit in the Economic Development of Small Farm Agriculture (Urbana: University of Illinois, 1973), p.23.

economic analysis.⁸⁴ Radhakrishnan employed this technique for determining optimum resource allocation in Coimbatore taluk of Tamil Nadu State for maximising farm income and the study revealed the existence of greater potentiality for increasing the income of the farmers through enterprise adjustments. However, these studies assumed that the resources are static in their availability. But in actual practice the resource availability can be augmented by acquisition.⁸⁵

In order to consider such changing situations sensitivity analysis was developed. In this system of

⁸⁴See for example: (i) T.C.Koopman, Activity Analysis of Production Allocation (ed. New York: John Wiley & Sons Inc., 1951), pp.339-347, (ii) E.O.Heady, "Simplified Presentation and Logical Aspects of Linear Programming Technique", J.Farm Econ., 36:1035-1050, 1954, (iii) James N.Boles, "Linear Programming and Farm Management Analysis", J.Farm Econ., 37:1-24, 1955 and (iv) R.Dorfman, P.A.Samuelson and R.Solon, Linear Programming and Economic Analysis (New York: McGraw Hill Book Company Inc., 1958)

For its application to problems of Indian agriculture see: (i) D.K.Desai, Increasing Income and Production in Indian Farming (Bombay: Indian Society of Agricultural Economics, 1963) and (ii) A.S.Kahlon and S.S.Johl, "Application of Linear Programming to Rotational Planting", Indian J. Agrl. Econ., 17:43-45, 1962.

⁸⁵S.A.Radhakrishnan, "Optimum Resource Allocation for Maximising Farm Income - An Application of Linear Programming Technique", M.Sc.(Ag.) Dissertation, University of Madras, 1969.

Programming, optimum plans can be derived for (i) changes in the resource constraints, (ii) changes in the objective function, (iii) changes in the coefficients/technological matrix, (iv) addition of new variables, and (v) addition of constraints.

Bowlen and Heady illustrated how the optimum plans differ with varying amounts of capital, labour and land restrictions.⁸⁶ McKee et al. estimated the optimum capital levels under which pasture improvements and renovation are profitable.⁸⁷ Heady and Loftsgard worked out plans for profit maximization with different levels of capital, labour, land and management.⁸⁸ Kandasamy, using the sensitivity analysis, predicted the supply response of the farmers, when prices of products and supply of resources are varied.⁸⁹

These sensitivity analysis studies have examined the farming conditions at different resource levels, at a point

⁸⁶ Bernard Bowlen and E.O.Heady, Optimum combination of Competitive Crops at Particular Locations, (Ames: Iowa Agriculture Experiment Station Bulletin, 426), 1955

⁸⁷ Dean E.McKee, Earl.O.Heady and J.M.Scholl, Optimum Allocation of Resources Between Pasture Improvement and other opportunities on Southern Iowa Farms. (Ames Research Bulletin-435, Iowa Agricultural Experiment Station), 1956.

⁸⁸ Heady Earl O, Laures, D.Loftsgard, Arnold Poulson and E.B.Duncan, Optimum Farm Plans for Beginning Farms on Fama Muscatine soils, (Ames, Research Bulletin - 440, Iowa Agricultural Experiment Station), 1956.

⁸⁹ A.Kandasamy "Supply Response of farmers to prices of select commodities in Coimbatore region - A Microlevel Analysis" (Ph.D.Thesis, Tamil Nadu Agricultural University, 1974).

of time. In actual condition decisions made at a point of time may not hold good for all the years to come.

Some of the farm management specialists have considered a longer time i.e., more than a year, as the planning period. Hildreth and Reiter have worked on the problem of selecting a crop rotation plan by an individual farmer.⁹⁰ However, the analysis of their study is static and is relevant to the long-run decision as to which basic rotation and cultivation plan to adopt as a fairly permanent practice. It does not bear on problems of possible year to year deviations in plans due to economic conditions experienced in a particular year or season.

This has led to the exploration of dynamic models which can accommodate the exogenous and endogenous changes in the farms. In dynamic models three approaches viz., (i) simulation, (ii) dynamic programming and (iii) multi-period linear programming are adopted.

Simulation has been described as the use of models for the study of dynamics of existing or hypothesized systems. This model merely calculates the results of the decision rule specified. They do not generate optimal solution. They are

⁹⁰Clifford Hildreth and Stanley Reiter, "On the choice of a Crop Rotation Plan" (ed. J.C. Koopman, Activity Analysis of Production Allocation, op.cit., pp.177-188), 1951.

used to handle multiple goals, indivisible inputs and concepts of organizational, managerial and behavioural theories.⁹¹

Eisgruber developed a programme to simulate a farm operation.⁹² It was strictly an operating model built around analyzing the effects of yearly plans and of land purchase decisions. The decision procedure followed the general land use planning approach. Input variables required for each year included acreage of each crop, fertilization levels, livestock number and types, and decision on land purchases. An option for stochastic yield and price co-efficients was provided. Harl has used a simulator to evaluate the impact of provided business organization on farm firm organization and expansion.⁹³

Patrick built a model simulating the entire farm business.⁹⁴ His annual farm operation sub-model was developed from Eisgruber's model, dropping the stochastic variable generator. This model draws extensively from behavioural concepts and uses for goals of the family, expectations on

⁹¹David A.Lins, "An Empirical Comparison of Simulation and Recursive Linear Programming Firm Growth Models", Agri. Econ. Res., 21:7-12, Jan. 1969

⁹²L.M.Eisgruber, Farm Operation Simulator and Farm Management Decisions Exercise, (Purdue Agri. Expt. Sta. Res. Prog. Rept. 162, Feb. 1962).

⁹³N.E.Harl, "Measurement of Selected Legal Economic Effects of the Corporate Business Organization". Ph.D.Thesis (Iowa State University, 1965)

⁹⁴G.F.Patrick, "The Impact of Managerial Ability and Capital Structure of Farm Firm Growth", Ph.D.Thesis (Purdue University, 1966).

prices and consumption function related to family size and income level.

Harshbarger has introduced stochastic yield and price variations to the model, added land purchase and machinery enlargement, and has developed certain other modifications.⁹⁵ His model also evaluated the impact of marginal ability and capital structure on farm firm growth.

Dynamic programming models have been developed to analyse the multistage decision process. A multistage decision process is characterized by the task of finding a sequence of decisions which optimises an approximately defined objective function. The stage is the interval into which the process is divided, a decision being made at each stage in the sequence of stages comprising the decision process. The state of the process, at a particular stage describes the conditions of the process and is defined by the magnitude of state variable.

Dynamic programming has been widely applied to problems of replacement and feed lot management by Jenkins and Halter,⁹⁶

⁹⁵C.E.Harshbarger, "The effect of Alternative Strategies used in Decision-Making on Firm Growth and Adjustment". Ph.D.Thesis (Purdue University, 1969).

⁹⁶K.B.Jenkins and A.N.Halter, "A Multistage stochastic Replacement Decision Model" (Oregon Agrl. Exp. Station Bull. 67, 1963).

and Schroder.⁹⁷ This model has not been applied to the problem of growth of the total farm firm. However, Minden has conceptualized the firm growth problem in a dynamic programming framework and discussed various advantages and disadvantages of this technique.⁹⁸

In dynamic Leontif model a choice is made at every instant of time, deliberately or by market mechanism. This model permits joint production so that a single productive activity can have more than one output.⁹⁹

Key developed a dynamic linear programming model to study farm firm growth in North Central Iowa. The model emphasized the dynamic inter-relationship between years and the objective function was specified to maximise discounted net returns over times. From an initial set of resource restrictions growth in the scale of production activities was allowed through activities which permitted the borrowing of capital, hiring labour, renting or purchasing land, purchasing machinery and expanding livestock facilities under a number of different technologies. His study indicated

⁹⁷W.S.Schroder, "Application of system Models to the Analysis of selected Swine Management Decision, "Ph.D.Thesis, Purdue University, 1968.

⁹⁸A.J.Minden, "Dynamic Programming: A Tool for Farm Firm Growth Research", Canadian J.Agrl. Econ., 16:38-45, June, 1968

⁹⁹Dorfman, R., P.A.Samuelson and R.Solon, Linear Programming and Economics Analysis. McGraw Hill Book Company Inc., New York. 1958.

that growth in the scale of production activities takes place in crop activities primarily by renting land and purchasing necessary machinery.¹⁰⁰

Day has developed yet another model called Recursive Programming.¹⁰¹ This is a different approach to describing the decision process of the farm firm. It involves specification of a recursive system to be solved in sequence, with slight alterations in each step. Restrictions for any given year depend on the optimum solution for the previous year. Flexibility constraints, consisting of upper and lower bounds on certain variables, are used to represent temporary limits placed upon the growth process by external factors.¹⁰²

The application of recursive programming by Day,¹⁰³ and Schaller and Dean¹⁰⁴ were based on a model for an area, and the growth concepts used were thus of an aggregate regional nature. Flexibility constraints consisted of restrictions on the rate at which profitable new technology

¹⁰⁰R.D.Kay, "A Dynamic Linear Programming Model of Farm Firm Growth in North Central Iowa, Ph.D.Thesis (Iowa State University, 1971).

¹⁰¹Richard H.Day, Recursive Programming and Production Response, (Amsterdam: North Holland Publishing Company, 1963)

¹⁰²George D.Irwin, "A Comparative Review of Some Firm Growth Models", Agr. Econ., Res., 20:82-100, July 1963.

¹⁰³Richard H. Day, op.cit. Ch.1.

¹⁰⁴W.N.Schaller and G.W.Dean, Predicting Regional Crop Production (U.S.Department, Agrl. Tech. Bulletin, 1329, April, 1965).

became available and on the rate at which labour would exist. On some external factors, both upper and lower limits were included.

A further development of dynamic programming is multiperiod programming. Multiperiod programme defines a long-run plan over time with transition plans specified. In dynamic programming optimum plans are obtained separately for each year. The optimum plan of an year is used to specify the parameters for the succeeding year and thus the overall optimal solution is arrived at. In multiperiod programme the activities are specified separately for each production period. By making a built-in provision in the matrix for transfer of resources from one period to the next, the programme maximises the discounted net income over the long-run. Thus the multiperiod model yields a series of decisions over the time that are jointly optimal.¹⁰⁵

Examples of the utilization of multiperiod linear programming models to study growth problems are many. Following Dorfman's discussions of the applicability of linear programming to multiperiod problems,¹⁰⁶ Swanson

¹⁰⁵Keith G. Gowling and C. B. Eaker, "A Poly period Model for Estimating the Supply of Milk", Agr. Econ. Res. 15: 15-23, Jan. 1963.

¹⁰⁶Dorfman, R., P. A. Samuelson and R. Solon, op.cit.

developed the first multiperiod planning model.¹⁰⁷ It was an enterprise choosing model for planning over a five year period. The model had an activity to transfer part of income from one year to the next, over a \$ 5000 minimum consumption and fixed cost allowance. Loftsgrad and Heady developed a multiperiod model by expanding the ordinary simplex model.¹⁰⁸ The model involves solving optimum plans for a series of years where productivity of resources in the farm business are related to expenditure needs of the farm family.

Following in quick succession were the application of this technique by Irwin and Baker¹⁰⁹ which focussed on intra-year financial transfers, and Barr and Plaxico which emphasized capital flows among years.¹¹⁰ In an aggregate study Gowling and Baker used multiperiod linear programming to estimate regional milk supply or growing dairy farms.¹¹¹ Dean and

¹⁰⁷Earl R. Swanson, "Integrating Crop and Livestock Activities in Farm Management Activity Analysis", J. Farm. Econ., 37:1249-1258, Dec. 1955.

¹⁰⁸Lawral D. Loftsgrad and E.O. Heady, "Application of dynamic Programming Models for Optimum Farm and Home Plans", J. Farm. Econ., 41:51-67, Feb. 1959.

¹⁰⁹George D. Irwin and C.B. Baker, Effects of Lender Decisions on Farm Financial Planning (Illinois Agrl. Expt. Sta. Bull. 688, Nov. 1962)

¹¹⁰Alfred L. Barr and James Plaxico, Optimum Cattle systems and Range Investment Practices for Northern Oklahoma: Dynamic and Static analysis (Oklahoma Agr. Exp. St. Mis. Bull. 62, July, 1961)

¹¹¹Keith G. Gowling and C.B. Baker, "A Poly-period Model for Estimating the supply of Milk" Agr. Econ. Res. 15:15-23, Jan. '63.

Benedictis have used this model to device normative development plans through time for small land reform farms in Italy.¹¹² The specified objective function was to maximise the present value of the future net incomes, subject to restrictions on the levels of resources available.

Martin in his model used the optimal farm solution as a composite single production activity, called operating plan.¹¹³ All other activities were to invest in resources or to handle the transfer of funds between years. The production decision to be made each year is, therefore, the magnitude of one composite single activity specified. Johnson introduced the concept of risk into the multiperiod analysis.¹¹⁴

Lentz developed a poly-period linear programming model to establish investment and operating strategies a grain-live-stock farmer could follow to bring about orderly growth

¹¹²Gerald W. Dean and Michale De Benedictis "A Model of Economic Development in Peasant Farms in Southern Italy". J. Farm. Econ., 46:295-312, May, 1964.

¹¹³J.R. Martin, "Polyperiod Analysis of Capital accumulation and growth process of Farm Firm, Iowa's Rolling Plains of South Eastern Oklahoma", Ph.D. Thesis (Oklahoma State University, 1966).

¹¹⁴S.R. Johnson "An Analysis of some Factors Determining Farm Firm Growth", Ph.D. Thesis (Texas A & M. University, 1966). Also S.R. Johnson et al., Stochastic linear Programming and Feasibility Problems in Farm Growth Analysis. J. Farm Econ. 49: 908-919, Nov. 1967.

in his farm.¹¹⁵ This model is an extension of static linear programming model and allows for a simultaneous optimization over all the years in the planning horizon. The polyperiod matrix is organized in such a way that commodities brought or produced during one time period may be transferred to future time periods for sale, consumption or future production.

Barry used a multiperiod linear programming model to evaluate the effect of investments in indivisible land units on various measures of firm growth. The objective function specified for the model maximizes the present value of asset equity measured at the end of 10 year planning period.¹¹⁶

It can be observed from the review so far made that all the studies employing multiperiod linear programming have concentrated on the investment decisions, growth rate of farm firm and the terminal size of the firm. Multiperiod programming, as a tool, offers a good scope

¹¹⁵G.W.Lentz, "Investment Strategies for Grain-Livestock Farms: A Polyperiod Linear Programming Analysis"; Ph.D.Thesis (The University of Nebraska, 1971)

¹¹⁶Peter J. Barry, "Asset Indivisibility and Investment Planning: An Application of Linear Programming", Am.J.Agrl. Econ., 54: 255-259, May, 1972.

to study the effects of resource changes of the farm firm over years. Resource changes are generated by initial investment financed by land development bank. The changes are multi-dimensional with respect to development of land capability, availability of irrigation facilities, saving and capital formation. The result of such changes is reflected in changes in crop system, output and farm size. The present study attempts to measure and evaluate all these changes in farm firm.

CHAPTER III

DESIGN OF THE STUDY

Sampling, Design and Procedure

The study was undertaken in Kancheepuram taluk of Chingleput district.¹ Out of the 15 districts in Tamil Nadu State Chingleput district was selected at random.

Chingleput district consists of eight taluks viz., Chingleput, Maduranthakam, Saidapet, Sriperumpudur, Kancheepuram, Thiruthani, Thiruvellore and Ponneri, and out of these eight taluks, Kancheepuram taluk was selected for the study by random sampling.

As discussed earlier long-term co-operative credit structure in Tamil Nadu consists of two tiers - State Land Development Bank (SLDB) at the apex level and the primary land development banks (PLDB) at the base. The policy in the organisation of primary land development banks till 1969 was to have normally one primary land development bank for each taluk. In 1969 the State Government took a policy decision to have one land development bank for each block.

¹A district is an administrative unit and there are 15 districts in Tamil Nadu State. Each district includes generally 5-12 taluks and each taluk comprises of three to five development blocks.

Accordingly, 117 primary land development banks were organised during 1969-70 at the block level. Subsequently, considering the question of viability of these primary land development banks, the Government decided to await for the experiences of the expansion at the first phase and therefore to go slow on further expansion at block level. By June 1975, there were 223 primary land development banks in the State out of which 182 were block level primary land development banks and 41 were taluk level primary land development banks. There was no overlapping of areas of operation between these two types of banks.

The structure and functioning of the apex and primary banks are governed by the Act: "Tamil Nadu Co-operative Land Development Banks' Act 1934". All the agriculturists competent to contract and own land in the area of operation of a primary land development bank are eligible for admission as members of the bank.

The Kancheepuram Co-operative Land Development Bank was established in the year 1925 and is one of the pioneer banks in the State. Till 1969-70 the area of operation of the bank was the entire taluk of Kancheepuram. From the year 1969-70 when the block level banks of Uthiramerur and Walajabad were formed, the area of operation of the bank was limited to Kancheepuram block only. The assets and liabilities of the bank were not, however, bifurcated. The present study

covered the whole of Kancheepuram taluk and therefore the beneficiaries of the three primary land development banks at Kancheepuram, Uthiramerur and Walajabad formed the universe for purpose of sampling.

The State Land Development Bank, Madras as noted earlier, raises resources by floatation of debentures from time to time, with the concurrence of the Reserve Bank of India and the Registrar of Cooperative Societies, the latter being a Trustee as per the provisions of the above said Act. The funds so raised are lent to the primary land development banks. They, in turn, canvass and process the loan applications as per the rules and guide lines issued by the Government from time to time, disburse the loan, as sanctioned by the State Land Development Bank, and get it reimbursed from the State Land Development Bank. Loans are issued on the mortgage of lands over which the applicant has got alienable right. The quantum of loan granted to an individual borrower is related to the value of the land offered as mortgage and/or the repaying capacity of the applicant.

Prior to 1964, the land development banks, (then land mortgage banks) in the State advanced loans for the discharge of prior debts. Since then the policy of the development oriented lending came into existence. Nevertheless during the year 1964 to 1968 lending was mainly for the purpose of discharge of prior debts incurred for land improvement purposes. Hence the type, size and nature of improvement made with the loans disbursed

during these years could not be known from the available records.

In the financial year 1968-69, the Reserve Bank of India categorised the purpose of lending into three: (i) identifiable productive purposes, (ii) unidentifiable productive purposes and (iii) others, and advised the State Land Development Banks in the country to ensure that 90 per cent of their loans are advanced for productive purposes. It also insisted that at least 70 per cent of this should be for easily identifiable productive purposes. The purposewise lending directly for developmental purposes, therefore, commenced from the year 1968-69.

For any loan there is a time lag between disbursement of the loan amount and its final utilization. This period is usually considered to be an year for long-term productive purposes. Since the study envisaged to estimate the benefits accrued to the farms it was considered that the study should be limited to those beneficiaries who have realised the benefits of development. Further, the study also aimed to estimate the trend and process of development during the course of repayment of loan. Considering these factors, the universe for the study was limited to the loans issued during the period from 1968-69 to 1972-73.

Loans under the 'developmental lending' for agricultural purposes are classified as follows:-

- (i) Minor-Irrigation
 - (a) Sinking of new well
 - (b) Deepening of existing well
 - (c) Installation of pumpset
 - (d) Laying out pipeline

- (ii) Farm Mechanization
 - (a) Purchase of tractor
 - (b) Purchase of other farm machinery like power tiller, sugarcane crusher, threshing machines etc.

- (iii) Land Reclamation
 - (a) Land levelling
 - (b) Compartmental bunding
 - (c) Applying silt and soil amendments

- (iv) Others
 - (a) Other production purposes like raising orchards
 - (b) Construction of cattle shed, farm house, fencing etc.
 - (c) Discharge of prior debt
 - (d) Purchase of land

During the study period, 1968-69 to 1972-73 loans were disbursed by the primary land development banks, Kancheepuram,

Walajabad and Uthiramerur, for various purposes, as detailed below.

TABLE I
PURPOSEWISE DISTRIBUTION OF LOANS IN KANCHEEPURAM TALUK DURING
1968-69 TO 1972-73

Sl. No.	Purposes	Number of loans	Total amount disbursed Rs. in '000	Percentage to total amount disbursed
i.	Minor-Irrigation	2663	18798	65.80
ii.	Farm Mechanization	297	7416	25.96
iii.	Land Reclamation	458	1812	6.34
iv.	Others	185	543	1.90
	Total	3,603	28,569	100.00

Based on the number of loans issued, the three important purposes, namely, minor-irrigation, farm mechanization and land reclamation were taken up for the study.

Loans issued under the three categories were listed out and a sample of 200 beneficiary farms were selected by random sampling at the rate of 100 for minor-irrigation, 50 for farm mechanization and 50 for land reclamation.

The loan records of the primary land development banks did not reveal the actual operational holding of the borrowers but only indicated the extent of hypothecated land. For the

purpose of analysis and interpretation of results, the sample farms were post stratified into small, medium and large size groups based on the size of operational holdings, the information of which was obtained during the enquiry from the sample farms.

Data requirements

The study was mainly based on primary data collected by personal interview with respondent farmers with the help of a pre-tested questionnaire. The details and information regarding the loans received from the land development bank and other sources, cost of loan, investments made, family size etc., were collected. The questionnaire was designed to collect specific information regarding the pre-development and post-development situations in the farms pertaining to size of holding, type of lands viz., wet, garden and dry lands, sources of irrigation and availability, livestock, dead stock and other assets, labour and other inputs, costs and returns of farm business, liabilities and family expenses. Also pattern and costs of operations, cropwise, were collected for pre-development and post-development conditions.

Particulars regarding villagewise and talukwise cropping pattern, labour force, prices, sources of irrigation and other general particulars were collected from secondary sources such as village and taluk accounts and District Statistical Office. Data were also collected from the other sources like Government Publications, reports and other published material.

Depending upon the year of occurrence of the development i.e., from the time benefits started flowing, particulars for two to five years were collected from the farmers for the post-development analysis. The data with respect to pre-development situation were also collected from the sample farms for comparative study.

Due to limitations of time and other facilities, survey method was adopted for collection of data. Each farmer was interviewed atleast twice, to test check the quality of the information gathered and for missing data, if any. Wherever possible cross checking of the data collected from primary source with secondary source was done to achieve maximum possible accuracy.

Tools of Analysis

In what follows, various tools of analysis employed in the study are noted briefly.

(i) Percentage analysis

The nature of the study being the comparison of cropping pattern, structure of assets and liabilities, input use and returns from farms in the pre-development and post-development situations, the percentage analysis was used.

(ii) Rank correlation

The correlation coefficient is a measure of the relationship between the two variables given by the ratio of

the product moment of the two variables. When the exact measurement of the variable is not possible recourse is taken to calculation of rank correlation co-efficient. This is an ordinal measure analogous to product moment correlation, calculated when there are two sets of ranks, the ranks being assigned on some criterion.² This technique is mainly applied in this study to evaluate shifts in cropping pattern due to the execution of developments in the farm with the help of state land development bank finance. Here the ranks are assigned to the various crops based on their percentage of the total cropped area.³

(iii) Capital budgeting

Capital budgeting is the technique concerned with the allocation of the farmers' scarce financial resources among the available opportunities for productive investments in the farm. Of the different criteria available for capital budgeting the Internal Rate of Return (IRR) method was used for evaluating the various types of investments in the farm and to suggest most profitable manner of investing scarce financial resources. The IRR is defined as that discount rate which makes the net present value of all the cash inflows equal to the net present

²Kendal's Rank Correlation as quoted by T.V.Ramasubban, "Some Statistical Measures to Determine Changes in Cropping Pattern". Agric. Situ. India, 17:1153-58, November, 1963.

³B.Sridharan, "A Micro-Level Study on Factors Influencing Cropping Pattern in Coimbatore district", Ph.D.Thesis (Tamil Nadu Agricultural University, Coimbatore, 1971).

value of all the cash outflows. In practice IRR was calculated by evaluating the Net Present Value (NPV) of several discount rates and then determining the discount rate corresponding to a zero NPV by graphical interpolation.

In the present study capital budgeting was done to estimate the returns from the various types of activities connected with minor irrigation, farm mechanisation and land reclamation works.

(iv) Multiperiod linear programming

As discussed in the second chapter, a multiperiod linear programming model was specified in the study to analyse production investment decision in the farms.

The multi-period linear programming defines a long run plan over time with transition plans specified. The model of this study specifies activities separately for each production period and provides for opportunities for transfer of resources from one period to the other and acquisition of resources from the savings accruing in the previous period to maximise discounted net income over the long run. The optimum solution for any one period depends on the optimum solution(s) of the previous period(s) and on the requirements for consumption, loan repayments, maintenance cost of the assets and other fixed liabilities.

The multiperiod linear programming was used in this study to analyse and evaluate production investment decisions and to maximise the present value of future returns over five periods of each two years.

CHAPTER IV

BACKGROUND OF THE AREA STUDIED

General Description

The area studied forms part of Chingleput district, which is one of the coastal districts of Tamil Nadu. This district comprises of eight taluks of which Kancheepuram taluk is one wherein the study was undertaken.

The total area of the taluk is 2861.82 sq.km. The taluk is bounded on the north and east by Tiruvellore, Saidapet and Chingleput taluks and on south and west by the North Arcot district. The taluk lies between $12^{\circ}30'$ & $13^{\circ}0'$ north latitude and $79^{\circ}32'$ and $79^{\circ}55'$ east longitude.

The taluk consists of three community development blocks namely Kancheepuram, Uthiramerur and Walajabad. The location of the district, taluk and the three blocks are shown in Fig.1. The sample holdings are distributed in 26 villages. The location of these villages in the taluk are shown in Fig.2.

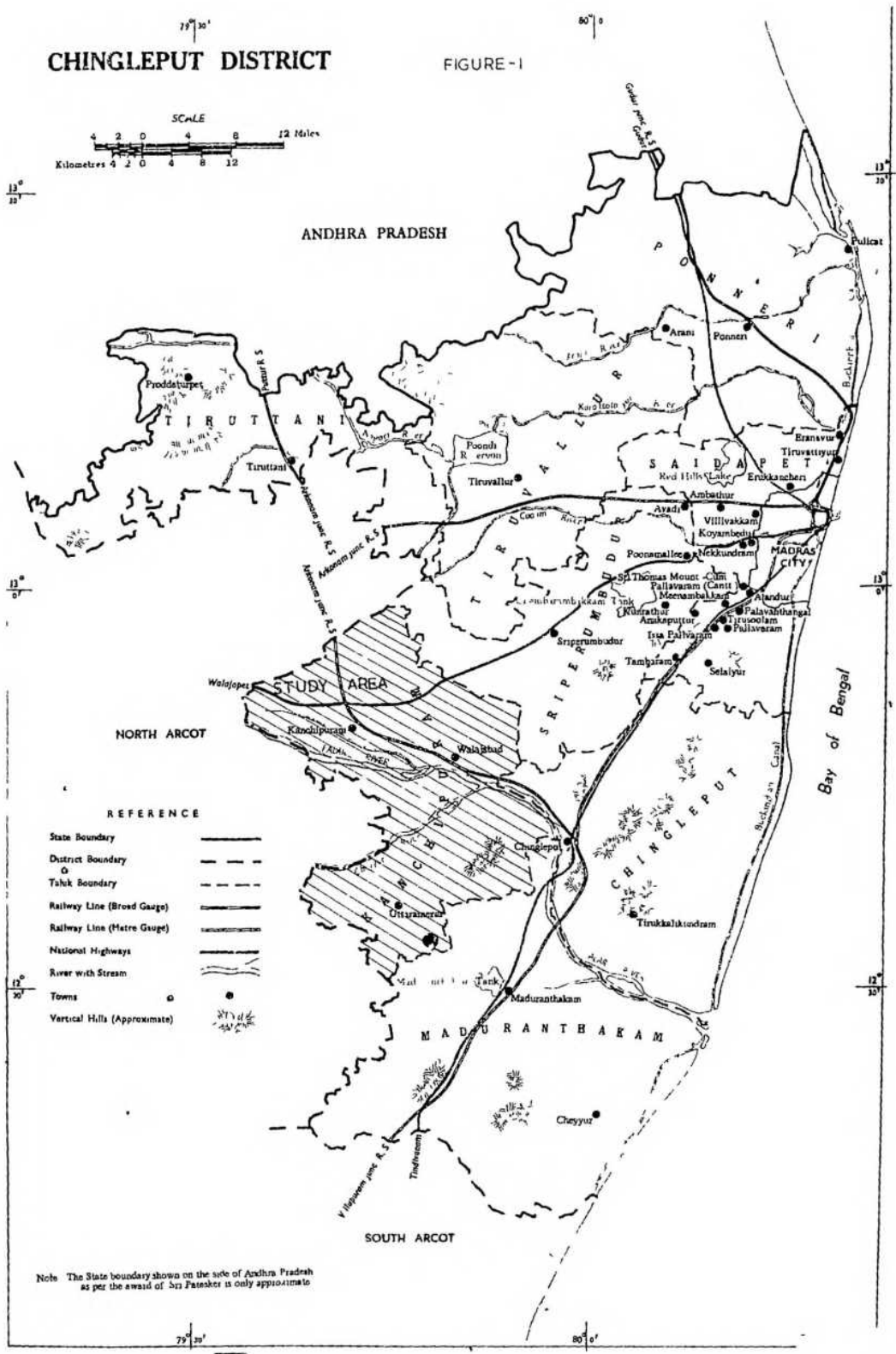
The basic particulars regarding area, population and literacy of the three blocks are given in Table-II.

Climate and Rainfall

The taluk has a tropical climate in general. The mean daily temperature ranges from 20.3°C to 37.6°C .

CHINGLEPUT DISTRICT

FIGURE-1

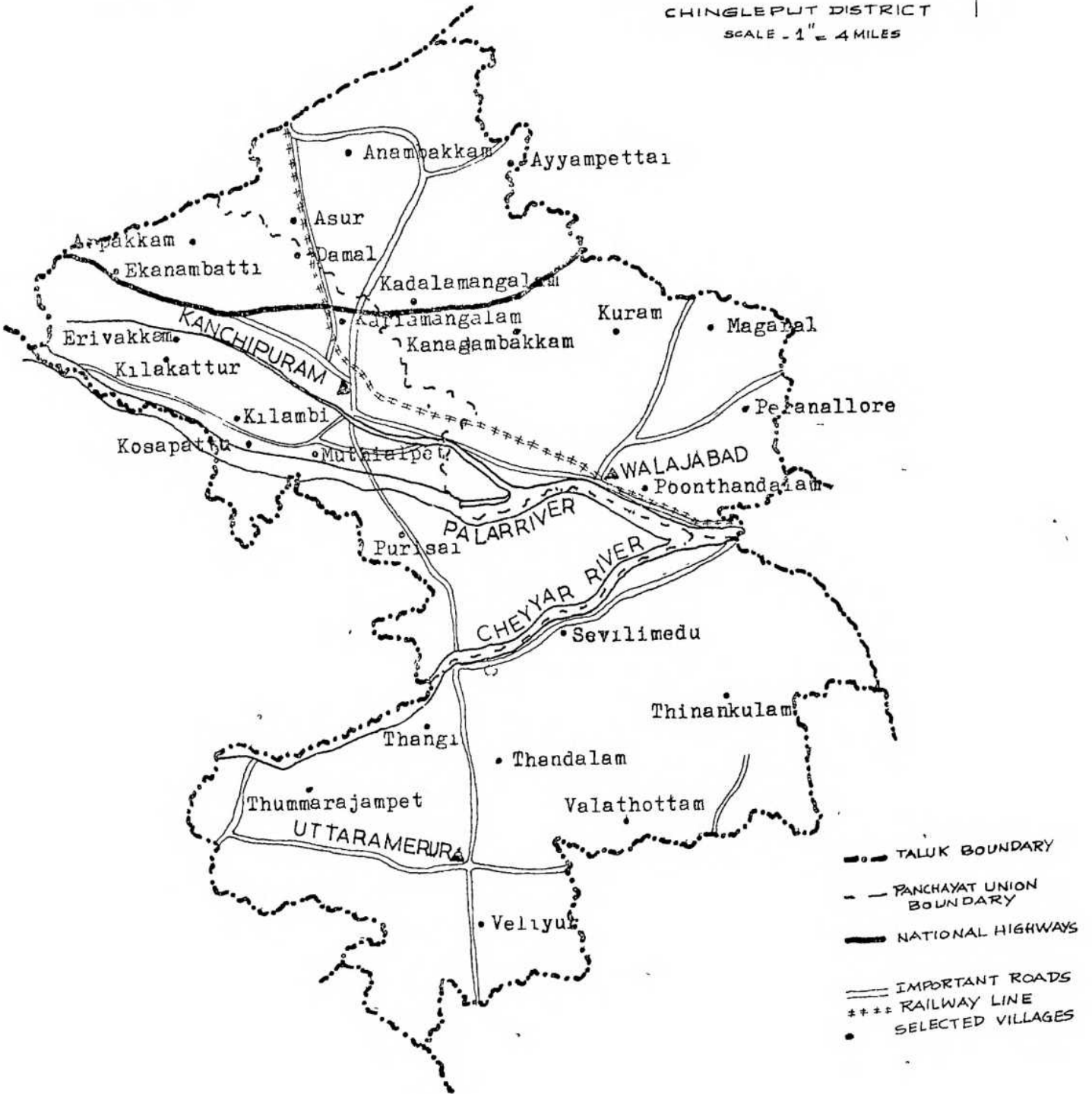


Note: The State boundary shown on the side of Andhra Pradesh as per the award of Sri Patilkar is only approximate.

FIGURE - 2

KANCHIPURAM TALUK

CHINGLEPUT DISTRICT
SCALE - 1" = 4 MILES



- TALUK BOUNDARY
- PANCHAYAT UNION BOUNDARY
- == NATIONAL HIGHWAYS
- == IMPORTANT ROADS
- +++ RAILWAY LINE
- SELECTED VILLAGES

TABLE II

AREA POPULATION AND LITERACY DETAILS OF THE THREE BLOCKS IN KANCHEEPURAM TALUK
(As per 1971 census numbers)

Particulars	Kancheepuram Block	Walajabad Block	Uthiramerur Block
Area in sq. km	306.15	378.24	420.56
Population			
Total	117499	155756	104200
Males	60305	79948	53484
Females	57194	75803	50716
Literate persons			
Total	32109	14770	6931
Males	23464	10614	4719
Females	8645	4156	2212
Agricultural labourers & cultivators			
Total	18118	27863	30355
Males	13785	21561	24413
Females	4333	6302	5942

Source: The Directory of Census operations, Madras.

April and May are the hottest months of the year and December and January are the coldest months. The taluk experiences uniformly bright sunshine for a major period of the year.

Rainfall is the major factor influencing the agricultural production of this area. The quantum of rainfall and its distribution greatly influences the area under different crops and technique of cultivation. Based on the pattern of rainfall four distinct seasons are identified. The rainfall recorded in these seasons for a period of five years is given in Table III.

It can be observed from the table that a major portion of the rainfall is received during north-east monsoon and south-west monsoon periods. The distribution of rainfall in these two seasons have a direct and significant influence on the agriculture of the area, since these are the main cropping seasons. In general during the year under study, the area has experienced a normal climate and rainfall.

Soils

The soils of the taluk are mainly red sand and gravel with moderate area of red loams and clay. The soils are comparatively inferior to other soils in the State.

A major part of the tract has got upper Gondwana, sand stone and shale formations. There are also charnockites and gneisses, particularly in the west and south of the taluk.

TABLE III

RAINFALL PARTICULARS, SEASONWISE, IN KANCHEEPURAM TALUK FOR FIVE YEARS FROM 1968-69 to 1972-73
(Millimeters)

Seasons	Year	1968-69	1969-70	1970-71	1971-72	1972-73
1. South-West monsoon period (June to September)		314.1	477.6	593.1	528.3	386.2
2. North-East monsoon period (October to December)		278.5	1002.8	348.2	480.4	1031.1
3. Winter period (January and February)		--	--	20.2	15.4	--
4. Hot-weather period (March to May)		62.0	52.4	213.6	171.8	3.4
Total rainfall		654.6	1532.8	1175.1	1195.9	1402.7

Source: District Statistical Office, Kancheepuram.

These crystalline rocks are overlain by deep alluvium up to a depth of about 20 meters and more at places, along the Palar river and its tributaries.¹

The alluvium has got substantial ground water potential and wells sunk in these areas yield adequate supply of water.

Irrigation

Tanks, wells and rivers are the main sources of irrigation in the area.

The tract is traversed by the Palar river and its tributaries. In addition Courtaliyar river also feeds a few villages in the north and the west of the area. Canals of Palar river also feed a chain of tanks. However, the flow of water in the canals is entirely dependent upon the quantum and distribution of rainfall. Apart from the tanks linked to the river systems, there are large number of tanks that receive water from their own catchment areas and are entirely dependent on the precipitation. Availability of irrigation from the tanks varies from four to seven months depending upon the size of the catchment area, ayacut (area benefitted) to be commanded, depth of the basin and size of the tank.

¹Gazeteer of Chingleput District (Madras: Government Press, 1959).

Wells are primarily used to supplement tank irrigation in wet lands. Of late with fluctuations in the supply of water from the tanks and rivers, tapping of sub-soil water is being resorted to, on a large way. Wells provide an assured source of irrigation and supplement the other sources and also ensures profitable farm business, by increasing cropping intensity and crop yields.

The area irrigated by different sources of irrigation for the five years from 1968-69 to 1972-73 is presented in Table IV. A perusal of the table will reveal the fluctuations in the area irrigated by canals and tanks which can very well be correlated with rainfall. It can also be observed that in absolute figures there has been increase in the area irrigated by wells and area irrigated more than once except for the year 1970-71. Percentage wise, the share of wells in irrigated farming has shown its growing importance over years.

Land utilization

The pattern of land utilization² in Kancheepuram taluk is presented in Table V. From the table it can be seen that the net area sown forms only 51.02 per cent of the total

²It is customary in official records of Revenue Department to use ninefold classification of land utilization as given in Table V. Of the nine classes, cultivable waste, current fallows, other fallows and net area sown are of importance.

TABLE IV

AREA IRRIGATED SOURCE WISE IN KANCHEEPURAM TALUK FOR FIVE YEARS FROM 1968-69 to 1972-73
(Area in hectares)

Sl. No.	Classification	1968-69	1969-70	1970-71	1971-72	1972-73	Percentage increase or decrease over 5 years
1.	Government and private canals	12806 (5.24)	1980 (5.32)	1951 (4.64)	2167 (5.09)	1482 (3.53)	-0.52
2.	Tanks	20072 (71.42)	27711 (74.39)	29083 (69.11)	31399 (73.68)	29345 (69.91)	+46.20
3.	Wells (sole irrigation)	3561 (12.67)	4223 (11.34)	7122 (16.92)	4939 (11.59)	6361 (15.16)	+78.63
4.	Wells (supplimented irrigation)	2624 (9.34)	3120 (8.38)	3403 (8.09)	3808 (8.94)	4255 (10.14)	+62.14
5.	Other sources	373 (1.33)	216 (0.58)	524 (1.25)	302 (0.71)	530 (1.26)	+42.08
6.	Total net area irrigated	28105	37250	42083	42614	41973	+49.34
7.	Area irrigated more than once	10594	21299	21713	19642	21023	+98.34
8.	Gross area of crops irrigated	34974	55429	57932	62256	62996	+80.12

Source: District Statistical Office, Kancheepuram

Note : Figures in paranthesis are percentage to total area.

TABLE V

LAND USE CLASSIFICATION IN KANCHEEJURAM TALUK FOR FIVE YEARS FROM 1968-69 TO 1972-73

Sl. No.	Classification	(Area in hectares)					Percentage increase or decrease over 5 years
		1968-69	1969-70	1970-71	1971-72	1972-73	
1.	Forests	1348 (1.26)	1348 (1.26)	1348 (1.26)	1348 (1.26)	1348 (1.26)	---
2.	Barren and uncultivable land	162 (0.15)	162 (0.15)	200 (0.19)	200 (0.19)	200 (0.19)	23.19
3.	Land put to non-agricultural uses	35824 (33.60)	36546 (34.37)	37130 (34.82)	37144 (34.83)	37144 (34.83)	3.69
4.	Culturable waste	2610 (2.45)	2449 (2.30)	2174 (2.04)	1798 (1.69)	1798 (1.69)	-31.09
5.	Permanent pastures and other grazing lands	1234 (1.16)	1234 (1.16)	1454 (1.36)	1454 (1.36)	1454 (1.36)	17.84
6.	Land under miscellaneous tree crops and groves not included in the net area sown	1397 (1.31)	1397 (1.31)	1397 (1.31)	1397 (1.31)	1397 (1.31)	---
7.	Current fallows	7117 (6.67)	8424 (7.90)	7127 (6.68)	5079 (4.76)	8661 (8.12)	21.70
8.	Other fallow lands	2542 (2.38)	2852 (2.67)	2977 (2.79)	1902 (1.78)	1902 (1.78)	-25.17
9.	Net area sown	54397 (51.02)	52119 (48.88)	52824 (49.55)	56309 (52.82)	52727 (49.46)	-30.07
10.	Total geographical area by professional survey	106631	106631	106631	106631	106631	

geographical area indicating scope for change in the pattern of land use. It is to be noted that the area under cultivable waste has decreased by 31.09 per cent over the five years, indicating that such lands are being converted for cultivation and other uses. This is supported by the increase in area under land put to non-agricultural uses and area under current fallows. The percentage of net area sown shows fluctuations in the five years which may be due to seasonal variations. However, the cultivable area (net area sown plus current fallow) shows an increasing trend over the five years. It may be presumed that this trend is the result of tapping of ground water and land reclamation.

Cropping pattern

The area under crops for the five years from 1968-69 to 1972-73 is furnished in Table VI. It can be observed from the table that among cereal crops rice occupies a prime position accounting for 91.63 per cent to the total cropped area and it is followed by ragi 2.70 per cent. Among commercial crops groundnut is the major crop occupying 2.92 per cent of the total sown area. All other crops are of minor importance.

Rice is grown either as irrigated, or partly rainfed and partly irrigated, or rainfed crop. In tank-fed areas atleast one irrigated crop of rice is raised in a year. Some farmers sow rice as rainfed crop taking advantage of

TABLE VI

AREA UNDER CROPS IN KANCHEEPURAM TALUK FOR FIVE YEARS FROM 1968-69 TO 1972-73

Sl. No.	Crop	Year				(in hectares)					
		1968-69	1969-70	1970-71	1971-72	1972-73	Area	% to total	Area	% to total	
1.	Paddy	29829	50431	52170	51089	55504	90.64	51089	90.64	55504	91.62
2.	Cholam	15	7	2	2	9					0.02
3.	Cumbu	7	18	6	1	3		1	Neg.	3	Neg.
4.	Regi	2062	2069	1758	1317	1634	2.34	1317	2.34	1634	2.70
5.	Other cereals	2	57	28		3				3	Neg.
6.	Pulses	11	6	8	3	7	0.01	3	0.01	7	0.02
7.	Chillies	144	131	180	172	213	0.31	172	0.31	213	0.35
8.	Sugarcane	938	700	1013	1468	975	2.61	1468	2.61	975	1.61
9.	Fruits & vegetables	-	-	-	67	45	0.12	67	0.12	45	0.07
10.	Other food crops	95	-	48	-	2				2	Neg.
	<u>Total food crops</u>	33103	53419	55213	54151	58395	96.05	54151	96.05	58395	96.39
11.	Gingelly	306	343	261	183	329	0.32	183	0.32	329	0.56
12.	Groundnut	1513	1161	2427	2012	764	3.58	2012	3.58	764	0.56
13.	Coconut	-	-	-	24	24	0.04	24	0.04	24	0.04
14.	Cotton	7	2	30	2	43		2	Neg.	43	0.07
15.	Other non food crops	27	-	-	8	22	0.01	8	0.01	22	0.04
	<u>Total for non food crops</u>	1853	1506	2718	2205	2182	3.95	2205	3.95	2182	3.61
	<u>Total Crops</u>	34956	54925	57931	56356	60577	100.00	56356	100.00	60577	100.00

Source: District Statistical Office, Kancheepuram

early showers and convert it as irrigated crop if sufficient water is received in tanks. This is followed by the regular crop of irrigated rice. Thus two crops of rice are raised if favourable seasonal conditions prevail. In tankfed areas farmers having wells to supplement the irrigation, raise three crops. In a majority of such cases groundnut follows the preceding two rice crops.

In purely well irrigated farms where growing of three crops in a year is possible, groundnut - rice - groundnut rotation is followed. Even here, in years of very favourable monsoon rice - rice - groundnut rotation is followed.

In rainfed areas (dry lands) groundnut, rice and ragi are the crops commonly raised. Usually one crop is raised in dry lands in normal years and in favourable years a second crop is also raised.

Sugarcane, though a paying crop with relatively high product prices, is confined to small pockets adjoining to Palar river. The scope for increasing the area under sugarcane is limited due to soil alkalinity and poor fertility of soil. The scope for growing crops like banana, cotton, tobacco etc., are also limited due to the reasons stated above and also rainfall distribution.

Agrarian Structure

The study area is completely a Ryotwari area in that there are no intermediaries between the Government and the land holders. Consequent to a number of land reform measures the tenurial system has got adjusted and there are only a negligible proportion of tenants in the area. Since the study was made with the borrowers in land development bank, where a loan is advanced only for owners the sample consisted of only owner cultivators.

With the passing of the Madras Land Reforms (Fixation of Ceiling on land) Act, 1961, the Government have imposed a ceiling on agricultural holdings to a maximum of 15 'Standard acres'.³

Agricultural credit system

Apart from the three Primary Land Development Banks there are 16 branches of nationalised commercial banks and 95 primary co-operative societies catering credit to the farmers in the area.

Short-term loans chiefly to meet the cultivation expenses of crops and medium-term loans for the purchase of

³The Act has defined the standard acre, which varies from area to area with the 'Tharams' (Classification of lands on the basis of its productivity) and kist (land revenue). Approximately an acre of wet land irrigated by Government sources of irrigation viz., river canals and tanks, or four acres of dry land (rainfed lands) or two acres of garden land irrigated by wells, are reckoned as one standard acre in the study area.

cattle, machinery whose life period may not exceed five years are issued by the co-operative credit society and commercial banks. Long-term loans for the purposes mentioned in the earlier Chapter are issued by land development banks and commercial banks. It is of importance to mention that the issue of loan for minor-irrigation purposes is exclusively assigned to the land development banks in order to maintain the 'Ground Water Discipline' in tapping ground water.

Infrastructure

In the study area, Kancheepuram is the important town and it is the district headquarters of the Chingleput district. Walajabad and Uthiramerur are the major Panchayats. Kancheepuram is well connected by road and rail and is easily accessible from the metropolis of Madras city. Kancheepuram also has postal, telegraph and telephone facilities. Uthiramerur is connected only by all-weather road and is easily accessible from Kancheepuram and is much nearer to Chingleput the former district headquarters. Walajabad is also accessible by road and rail and has good communication facilities.

The agricultural produce of the area are marketed at Kancheepuram and Chingleput. In all the important villages weekly shandies are also held. They also serve as

marketing outlets. There is only one Regulated Market at Kancheepuram where organised sale of rice and groundnut are done. The Chingleput District Co-operative Marketing Federation with branches at Uthiramerur and Walajabad and other important villages also serves as a channel of marketing of farm products in addition to supplying of inputs to the farmers. There are a number of private wholesale and retail traders in agricultural commodities in the area. The proximity of the region to Madras city is an added advantage for the marketing, particularly of rice and groundnut.

CHAPTER V

RESULTS AND DISCUSSION

A. Description of Projects Identified in the Sample Farms

Land development bank loans were issued for specific projects. The projects were classified into three groups based on the purposes for which the loans were availed by the farmers. The three purposewise groups are: (i) Minor-irrigation farms - farms in which investments were made in irrigation projects, (ii) Mechanized farms - farms in which investments were made for the purchase of tractors and power tillers and (iii) Reclamation farms - farms in which investments were made for reclaiming lands. This classification and connotation were used throughout the present study. Under these major purposewise categories there were a number of projects each with different objectives. A project might have a single or multiple objective. The projects identified in the sample farms are given in Table VII.

A brief description of the projects are given below.

1. Minor-irrigation farms

As listed in Table VII nine projects were identified in the sample farms under minor irrigation purpose.

(i) New Well (N): In this project circular open wells with six or seven meters diameter are dug to a depth of about thirteen meters. Water is lifted out by use of bullock power.

TABLE VII

PROJECTS IDENTIFIED IN THE SAMPLE AND THE CODE USED IN THE THESIS

Sl. No.	Project	Code	Number in the sample farms		
			Small	Medium	Large
<u>I. Minor Irrigation Farms</u>					
i.	New well	N	10	--	2
ii.	New well + pumpset	NP	30	21	10
iii.	New well + pumpset + pipeline	NPL	1	4	4
iv.	New well + pumpset + reclamation	NPR	2	--	--
v.	Deepening of well	D	--	--	1
vi.	Deepening of well + pumpset	DP	--	4	1
vii.	Deepening of well + pumpset + pipeline	DPL	--	--	2
viii.	Deepening of well + pipeline	DL	--	3	2
ix.	Pipeline	L	--	3	--
<u>II. Mechanized Farms</u>					
x.	Use of tractors	MT	--	--	30
xi.	Use of power tillers	MPT	--	--	20
<u>III. Reclamation Farms</u>					
xii.	Improvement of dry land	RD	8	--	4
xiii.	Improvement of wet land	RW	8	--	--
xiv.	Converting dry land to garden land	RCG	6	10	--
xv.	Converting dry land to wet land	RCW	6	6	2

The maximum command area is generally limited to about one hectare, because of the capacity of the motive power i.e., bullocks. New wells provide irrigation facilities for conversion of rainfed dry land into irrigated land, and/or to supplement the tank water in the wet land. The area under irrigation increases considerably. It also increases the cropping intensity in the farms.

(ii) New well + Pumpset (NP): In this project lifting of water is done from new wells by energised pumpsets instead of bullock power. The quantity of water lifted by the energised pumpsets will be two to three times more than that by bullock power. The dimensions of the wells in these projects will be generally more than in the new well projects so that more water can be tapped from underground. Further in places where the water table is deep, say, more than thirteen metres lifting water by bullock power is difficult and in such cases energisation is necessary.

(iii) New well + Pumpset + Pipeline (NPL): This is an improvement over the previous project. Pipelines are usually laid out to lead water to lands located at a distant place due to fragmentation or to a land located at a higher elevation than that of the source. If the lands are level and are located in a compact block, pipelines are generally not laid out. But pipelines will facilitate better water management even where lands are level through minimizing conveyance losses.

Usually cement pipes with 15 cm to 23 cm diameter are used for laying out pipelines. Water is led to the fields by syphon system. The project cost varies according to the distance over which the pipelines are laid or the height of the overhead tanks or the syphons constructed. By laying out pipeline additional area is brought under irrigated cultivation. Generally, marginal dry lands are converted into irrigated land and their improvements have higher pay-off.

(iv) New well + Pumpset + Reclamation (NPR): This is also an improvement over the project, NP, specified above. Reclamation is carried out to make the lands fit for irrigation or for improving the soil condition and productivity. Even when wells are dug and dry lands are brought under irrigation, reclamation work, especially land levelling and compartmental bunding, has to be done to make the lands fit for cultivation of irrigated crops like rice. Reclamation measures for improving the soil conditions and productivity involve application of soil amendments like gypsum and tank silt. These enrich the soil condition and contribute to higher yields.

(v) Deepening of well (D): This project is carried out to augment the water supply in the existing wells. Farmers are concerned with expanding the area under irrigated agriculture. In most of the cases deepening is done in

energised wells. By deepening, the water storage and recuperation capacity of the wells are increased considerably and thereby the command area of the wells are increased. It could, therefore, be stated that this project is also as beneficial as that of new well project. Sometimes deepening of wells also involve repairs to wells, widening of the wells and vertical and radial drilling inside the wells.

(vi) Deepening of well + Pumpset (DP): The project envisages lifting of more water by energisation from wells which were hitherto using bullock labour. Further wells using bullock labour devices for lifting water will be usually shallow because of the limited capacity of the bullocks. Hence it will be necessary to deepen the wells before switching over from bullock drawn water devices to energisation. The implementation of this project will not only increase the cropping intensity in the existing irrigated area but also facilitate extension of irrigated agriculture in the farms.

(vii) Deepening + Pumpset + Pipeline (DPL): In addition to deepening of wells and installation of pumpsets, pipelines are laid out with similar objectives as explained in project NPL.

(viii) Deepening + Pipeline (DL): This project is carried out only in farms having energised wells. As explained earlier

pipeline is laid out to bring additional area under irrigation. To meet the additional water requirements deepening of wells are also carried out simultaneously.

(ix) Pipeline (L): Whenever there is surplus water potential in the well and portions of the farm remain unirrigated due to its location, pipelines alone are laid out.

2. Mechanized farms

Two types of projects were identified in the sample farms. Mechanization projects are carried out by the large farms only.

(i) Use of Tractors (MT): The primary aim of the farmer is to complete the preparatory cultivation of the fields in a short time, so that sowing can be done in the proper season. In farms having a vast area under dry lands, land preparation has to be done within shortest possible time to complete sowings before the loss of optimum moisture. With bullock power the coverage per day is less. The ratio of coverage between bullock power and tractor power is found to be 1:12. From the enquiry it was found that a portion of land had to left fallow in a number of farms because of bullock power restraints. Mechanization avoids this contingency. Wherever supply of human and bullock labour is inadequate, use of tractor is resorted to.

In addition to the benefits accruing to own farms, it also provides the farmer an additional source of income by way of custom service. Business motivated large farmers therefore usually go in for tractors.

(ii) Use of Power Tiller (MPT): Farmers having comparatively less acreage than tractor farmers and are holding an average area of about 7.98 ha go in for power tillers instead of tractors. Power tillers are mainly used in wet lands. Therefore farmers having a large proportion of area under wet lands purchase power tillers. Some farmers substitute bullock labour with power tiller as the maintenance of bullocks is becoming costlier.

3. Reclamation farms .

Four types of projects were identified under this purpose. They are:

(i) Improvement of dry land (RD): This project is contemplated to improve the productivity of the soil. The types of improvement done are (a) levelling, which facilitates the uniform spread of water in the fields ensuring better crop growth, (b) applying tank silt to enrich the unproductive sandy soil and (c) compartmental bunding of the fields to prevent soil erosion and for conservation of water.

(ii) Improvement of wet lands (RW): Here the improvements noticed are (a) applying tank silt to enrich the soil,

(b) reshaping of fields, whereby some small plots are combined and formed into a big plot so that field operations can be carried out effectively and facilitates adoption of better water management practices and (c) application of soil amendments like gypsum to correct soil alkalinity.

(iii) Converting dry lands to garden lands (RCG): This project is in real sense a supplementary project for digging or deepening of wells. Dry lands will usually be undulated, and unfit to receive irrigation. When a well is dug and irrigated farming is adopted, improvement such as land levelling and field bunding are to be carried out. These operations are usually carried out on a phased manner in the farms.

(iv) Converting dry lands to wet lands (RCW): In this case lands to be converted are dry lands adjacent to wet lands. But due to locational disadvantage, especially of higher field levels, these lands do not receive enough water. Its conversion involves lowering of field level by cutting and removing earth to facilitate the free flow of irrigation water.

B. General Features of the Sample Farms

(i) Farm structure: The projects, described above, are those identified on the basis of development reported in the sample farms. For the present study, 100 minor irrigation farms, 50 mechanized farms and 50 reclamation farms were

selected, as described earlier in "Design of the Study". The farms were post-stratified into small farms, farms having less than 2.024 ha (5.00 acres), medium farms, farms having 2.024 to 4.047 ha (5 to 10.00 acres) and large farms having more than 4.047 ha (10.00 acres).

The general features of the sample farms are presented in Table VIII. The data presented relates to the farming situations as existed at the time of enquiry i.e., 1974-75. A perusal of the table shows that the average size of holdings in the sample farms varied from 1.09 ha to 13.98 ha for different size groups and various purposes considered for the study.¹ The reclamation farms had the least size of holding and the largest size of holding was in the mechanization farms. The percentage of irrigated lands to total net area varied from 55.66 per cent to 100 per cent. The lowest percentage of irrigated land was recorded in the reclamation farms. These farms remained unreclaimed obviously because of lack of irrigation potential and meagre productivity.

The average number of bullock pairs per farm varied from 0.86 to 2.85 and the bullock units were high in reclamation farms, since the bullock drawn implements are used in

¹The averages were computed for size groups and beneficiaries classified on the basis of purposes of lending or borrowing. The averages are presented and discussed below.

TABLE VIII
GENERAL FEATURES OF THE SAMPLE FARMS

Sl. No.	Particulars	Units			Minor Irrigation farms			Mechanization farms			Reclamation farms		
		No.	Small	Medium	Large	Small	Medium	Large*	Small	Medium	Large		
1.	No. of farms studied	No.	43	35	22	50	28	16	6				
2.	Average size of farm (Gross)	ha.	1.27	2.91	7.26	13.98	1.09	2.99	7.48				
3.	Average size of farm (Net)	ha.	1.25	2.85	7.06	13.18	1.06	2.90	7.27				
4.	Irrigated area per farm	ha.	1.25	2.51	5.44	8.09	0.59	2.10	4.18				
5.	Percentage of irrigated area to total net area	Percent-	100	88.07	77.05	61.38	55.66	72.41	57.50				
6.	Unirrigated area per farm	ha.	--	0.34	1.62	5.09	0.47	0.80	3.09				
7.	Bullock pairs per farm	No.	0.86	1.82	2.76	2.25	1.00	2.12	2.85				
8.	Area per bullock pair	ha.	1.45	1.57	2.56	5.86	1.06	1.37	2.55				
9.	Average size of farm family	No.	4.91	6.01	6.75	7.48	3.26	5.64	5.68				
10.	Farm assets other than land buildings & livestock per farm	Rs.	3053.00	4229.00	8412.00	39504.00	345.00	5953.00	7755.00				
11.	Average of above assets per ha	Rs.	2442.00	1483.00	1191.00	1417.00	325.00	2053.00	1067.00				

* For Mechanization loans are received by large farms only

the reclamation process. The area per bullock pair ranged from 1.06 ha to 5.86 ha. The wide variation noticed in the area per bullock pair was due to lesser utilization of bullocks in the mechanized farms.

The average size of the family varied from 3.26 to 7.48 adult units and a positive relationship between the size of holding and the size of family was evident. The family size was comparatively high in the mechanized farms. In general farmers living in a joint family system and owning a large operational holding especially of dry or wet land purchased tractors. Further they prefer to have the tractors operated by their own family members rather than hired driver to ensure better maintenance. Thus the large size of family in the mechanized farms can be reasoned out.

The value of assets other than buildings, land and livestock ranged between Rs.345 and Rs.39,504 per farm. The assets were low in the reclaimed farms and highest in the mechanized farms. Eventhough the value of assets per farm were high in the mechanized farm, their proportion per hectare was less. The value of assets per hectare varied from Rs.325 to Rs.2442. The highest value was noted in the small farms with minor-irrigation projects.

From the foregoing discussions the following general conclusions can be drawn. First there was variation in the resource position between the different size groups;

second there was also wide variation in the resource position of the farmers of different purposewise groups.

(ii) Purposewise distribution of loans: The size of farms and quantum of loan availed of purposewise by the sample holdings are furnished in Appendix A and abstracted in Table IX. Out of 100 minor-irrigation farms, 43 were small farms, 35 were medium farms and 22 were large farms. The investments were primarily for sinking of new wells, deepening of existing wells, installation of pumpsets and laying out pipelines. Loans were availed of, as discussed earlier, either for single purpose or for a combined purpose having various combinations. In one case a loan was utilized for a complementary purpose viz., land reclamation, in combination with minor-irrigation development. In all there were nine types of projects with single or combined purpose. The major purpose for which loans were used was construction of wells with pumpsets. It can be seen that 69.77 per cent, 60 per cent and 45.45 per cent of loans in the small, medium and large farms respectively were utilized for this purpose. Next in importance were single purpose project viz., construction of new well and a combined purpose project viz., construction of new well with pumpset and pipeline.

Only large farmers have availed of loan for mechanization projects. Of the total sample farms of 50 under this

TABLE IX
AVERAGE LOAN AMOUNT SANCTIONED PER FARM, CLASSIFIED
PURPOSEWISE

Sl. Purpose/ No. Project	Small Farms		Medium Farms		Large Farms	
	No.	Average loan amount sanctioned	No.	Average loan amount sanctioned	No.	Average loan amount sanctioned
<u>I. Minor-Irrigation</u>						
1. N	10	4000	--	--	2	6000
2. NP	30	8000	21	8500	10	9750
3. NPL	1	11000	4	7000	4	14000
4. NPR	2	7200	--	--	--	--
5. D	--	--	--	--	1	5000
6. DP	--	--	4	6500	1	7000
7. DPL	--	--	--	--	2	8500
8. DL	--	--	3	7500	2	12000
9. L	--	--	3	6750	--	--
Total Average	43	7102	35	7864	22	9932
<u>II. Mechanization</u>						
1. MT					30	35000
2. MPT					20	10000
Total Average					50	25000
<u>III. Reclamation</u>						
1. RD	8	2400	--	--	4	5900
2. RW	8	2600	--	--	--	--
3. RCG	6	3500	10	5800	--	--
4. RCW	6	3400	6	3900	2	4500
Total Average	28	2907	16	5088	6	5433

group, 30 had obtained loans for the purchase of tractors and 20 for the purchase of power tillers.

Out of the fifty reclamation farms, 28 were small farms, 16 were medium farms and six were large farms. Loans were availed of for four types of projects mentioned in tables VII and IX. It may be noted that maximum number of loans were used for converting dry land to garden land and next in importance, was for converting dry land into wet land. These projects were mainly undertaken with the purpose of utilizing the water potential available in the farm to the fullest extent.

It may be seen from table IX that the average quantum of loan utilized for all the purposes shows an increasing trend with increase in size group. This is because large farmers could obtain higher amounts of loan due to their higher repaying capacity estimated on the basis of assets owned.

(iii) Loan amount availed and actual project cost: Land development banks advance loans to a maximum of 90 to 95 per cent of the total estimated project cost and insist that the rest should be contributed by the farmer, from his own funds. This is done in order to create a stake for the farmer in the project. This is a general principle of lending observed by all types of financing institutions, though the quantum of borrowers' contribution varies with the project and institutions. In some cases, the value of security offered by the borrowers

are considered to reflect their repaying capacity which imposes a limit on the quantum of loan that can be sanctioned.

Farmers, in certain cases, modify the design at the time of execution, to suit their individual taste and requirements thereby increasing the project costs. Moreover, during the intervening period between the date of utilization of loan and the execution and completion of the project, project costs may have to be revised due to changes in factor prices. There is also a ceiling for the quantum of loan to be advanced for certain purposes.

For all the projects the final project cost, as incurred by the farmer, executed the loan amount, provided to him. The final project outlay and the loan amount availed by the farmers are given in Table X.

The difference between the loan amount availed and the actual project cost varies from zero to 147.05 per cent in minor-irrigation farms, 11.43 per cent to 23.00 per cent in the mechanized farms and 3.39 per cent to 25.00 per cent in the reclamation farms. The variations were found to be high in minor-irrigation projects as compared to the other projects. The reason was that a correct estimate of the project cost could not be made as the variations in soil conditions, ground water level and site of development could be wide and difficult to decide in advance. The highest variation was noticed on large farms investing on deepening + pumpset + pipeline project

TABLE X

COMPARATIVE STATEMENT OF THE LOAN AMOUNT SANCTIONED AND THE PROJECT OUTLAY

Sl. No.	Purpose/ Project	Small Farms				Medium Farms				Large Farms			
		Loan amount	Project outlay	Difference	Percent- tage	Loan amount	Project outlay	Difference	Percent- tage	Loan amount	Project outlay	Difference	Percent- tage
<u>I. Minor-Irrigation</u>													
1.	N	4000	5500	1500	37.50	--	--	--	--	6000	7000	1000	16.67
2.	NP	8000	9200	1200	15.00	8500	9500	1000	11.75	9750	11500	1750	17.95
3.	NPL	11000	11500	500	4.55	7000	11500	4500	64.29	14000	16000	2000	14.29
4.	NPR	7200	9500	2300	31.94	--	--	--	--	--	--	--	--
5.	D	--	--	--	--	--	--	--	--	5000	5000	--	--
6.	DP	--	--	--	--	6500	7500	1000	15.38	7000	7700	700	10.00
7.	DPL	--	--	--	--	--	--	--	--	8500	21000	12500	147.05
8.	DL	--	--	--	--	7500	8500	1000	13.33	12000	14000	2000	16.67
9.	L	--	--	--	--	6750	7500	750	11.11	--	--	--	--
Average		7102	8407	1305	18.37	7864	9485	1379	17.53	9932	11213	2600	26.18
<u>II. Mechanization</u>													
1.	MT	--	--	--	--	--	--	--	--	35000	39000	4000	11.43
2.	MPT	--	--	--	--	--	--	--	--	10000	12200	2200	22.00
Average		--	--	--	--	--	--	--	--	25000	28280	2545	10.18
<u>III. Reclamation</u>													
1.	RD	2400	3000	600	25.00	--	--	--	--	5900	6100	200	3.39
2.	RW	2600	3000	400	15.38	--	--	--	--	--	--	--	--
3.	RCG	3500	3900	400	11.43	5800	6500	700	12.07	--	--	--	--
4.	RCW	3400	3800	400	11.76	3900	4300	400	10.26	4500	5000	500	11.11
Average		2907	3279	457	15.73	5088	5675	588	11.56	5433	5733	300	5.52

which is mainly because of the ceiling limit for pipeline advances i.e., Rs.5000/- for an individual.

The average difference between the actual cost of the project and the loan amount availed of was higher in the large farms than in the small farms because large farmers were making changes and alterations in the projects to suit their conveniences and tastes.

C. Pre and Post-Development Analysis

After having studied the quantum of loans availed of and the actual project cost, for all the types of the projects undertaken by the farmers, it is necessary to study the influence of these projects on land type, cropping intensity, income asset pattern and working capital.

(i) Changes in land type: Based upon the irrigation source, lands are usually classified into three types viz., wet land, garden land and dry land. Wet lands are those which are low lying and are irrigated by surface flow from river, canals and tanks. The maintenance of the canals and tanks are vested with the Government and the distribution of water is regulated by certain set practices and rules framed thereof. They also include lands mainly irrigated by surface water and by supplemental source of irrigation by wells. Garden lands are those which are comparatively on higher levels and are irrigated by ground water sources such as open dug wells, tube wells and

filter points. These irrigation sources are owned and operated by the farmers. Dry lands are upland areas with no source of irrigation and where lands are cultivated purely under rainfed conditions.

Since wet lands are generally low lying areas their suitability for growing of certain crops is limited, whereas garden lands which are comparatively at a higher level and have assured source of irrigation are cosmopolitan in nature. Water flow can be regulated at farmer's own will in garden land and therefore scope for better water management and adoption of improved technology is large. Dry lands are generally less productive and subjected to the influence of the vagaries of monsoon. They offer scope for conversion into garden land by tapping ground water and adopting necessary reclamation work.

As mentioned earlier, conversion of dry land into irrigated land offers better scope for farm growth. Therefore, most of the capital investments on minor-irrigation, agricultural machinery and land reclamation are done with this objective in view. The influence of these projects on land type of the sample farms are presented in Table XI and discussed below.

As could be seen from the table the rate of change in minor irrigation farms representing conversion of dry lands into garden lands was the maximum i.e., 100 per cent, in small farms, whereas the conversion rate vary from 67.3 per cent to

TABLE XI
LAND TYPE WISE AREA IN THE SAMPLE FARMS IN PRE- AND POST-DEVELOPMENT SITUATIONS

S. Project No. code	Land type Situation	Small				Medium				Large							
		Wet	Garden	Dry	Per cent of irrigated land to total area	Wet	Garden	Dry	Per cent of irrigated land to total area	Wet	Garden	Dry	Per cent of irrigated land to total area				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
<u>I. Minor-Irrigation</u>																	
1. N	Pre-dev.	0.874	-	0.235	79	100							3.820	-	1.720	69	100
	Post-dev.	0.874	0.235	-	100								3.820	1.720	-	100	
2. NP	Pre-dev.	0.518	-	1.036	33	100	1.137	1.590	42	75.03	56		3.537	0.425	3.096	74	39.86
	Post-dev.	0.518	1.036	-	100		1.137	1.198	85	67.33	76		3.537	1.659	1.862	60	37.60
3. NPL	Pre-dev.			1.720	-	100	0.983	2.651	27				4.476	0.627	3.359	75	
	Post-dev.			1.720	-	100	0.983	1.785	0.866				4.476	1.890	2.096		
4. NPR	Pre-dev.			0.979		100											
	Post-dev.			0.979	-	100											
5. D	Pre-dev.												4.128	-	0.405	91	Nil
	Post-dev.												4.128	-	0.405	91	
6. DP	Pre-dev.										100		9.942	-	2.886	58	70.13
	Post-dev.										100	Nil	3.942	2.024	0.862	87	
7. DPL	Pre-dev.												4.185	0.405	2.088	69	59.67
	Post-dev.												4.185	1.651	0.842	87	

TABLE XI CONTINUED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
II. Mechanization																	
1.	MT	Pre-dev.											8.389	0.927	8.385	53	Nil
		Post-dev.											8.389	0.927	8.385	53	
2.	MPT	Pre-dev.											4.723	1.493	-	100	Nil
		Post-dev.											4.723	1.493	-	100	
Average		Pre-dev.											6.923	1.153	5.031	62	--
		Post-dev.											6.923	1.153	5.031	62	
III. Reclamation																	
1.	RD	Pre-dev.	0.121	-	1.109	10	--						3.557	-	4.423	45	Nil
		Post-dev.	0.121		1.109	10							3.557	-	4.423	45	
2.	RW	Pre-dev.	1.089			100	--										
		Post-dev.	1.089			100											
3.	RCG	Pre-dev.		0.704	0.356	66	100	1.016	0.870	1.101	63	68.39					
		Post-dev.		1.060		100		1.016	1.623	0.348	88						
4.	RCW	Pre-dev.	0.429		0.364	46	100	2.465	-	0.295	89	100	5.435	-	0.421	93	100
		Post-dev.	0.793		-	100		2.760	-	-	100		5.856			100	
Average		Pre-dev.	0.438	0.151	0.471	56	32.70	1.559	0.544	0.799	72						72.72
		Post-dev.	0.516	0.227	0.317	70		1.670	1.014	0.218	92						

100 per cent in medium farms and 37.6 per cent to 100 per cent in large farms. It could be interesting to note also that there was no change in the area under wet land in any of the size groups. However, in one case in which the project was to increase the area under wet lands by laying pipelines which involved conversion of dry land to wet land by 0.113 ha.

The predominance of investment on new wells in the small and medium farms clearly showed the pattern of demand for long-term credit for farm development, through increasing the area under garden lands amenable for sound soil and water management practices. On the other hand investment in deepening of existing wells and improving irrigation structures to minimize conveyance loss of scarce water, were found to be major problems of farm development in medium and large farms. This would also reveal the structural characteristics of physical assets of the farms vis a vis the size of the farms. The medium and large farms had wells for purpose of irrigation as well as to supplement other sources of irrigation and what was needed in these farms was improvement of existing irrigation structures, for which finance was provided. On the other hand, small farmers were not endowed with such irrigation facilities initially and to remove these serious constraints for farm development, finance was provided by the land development banks which helped in creation of new physical assets in the farm and capacity to increase output and income.

It may also be realised that in general the small farms were the actual beneficiaries of long-term finance provided by land development banks. Therefore, the small farms might have invested in single well, whereas medium and large farms might have used the finance in digging additional wells to stabilise the area under irrigation.

Investment in mechanization involving purchase and use of tractors and power tillers was limited to large farms only. The changes in the area under wet, garden and dry lands were not reported as the improvement through mechanization were manifest in farm costs and saving labour and time.

In reclamation farms the change in land type was noticed only in two projects where the projects were carried out purposely for such conversion. In other cases there were no change in land type.

(ii) Cropping Intensity: Cropping intensity is an important parameter to measure the development of farms. It is also a factor contributing to the farm income. The cropping intensity for this study is defined as the ratio of the gross cropped area to the net cultivable area of the farm expressed as a percentage. The data regarding cropping intensity in the pre and post-development stages in all the sample farms are presented in Table XII.

TABLE XII

CROPPING INTENSITY IN SAMPLE FARMS IN PRE- AND POST-DEVELOPMENT SITUATIONS

Sl. No.	Purpose/ Project	(Per cent)					
		Small Farms		Medium Farms		Large Farms	
		Pre- dev.	Post- Incre- ase	Pre- dev.	Post- Incre- ase	Pre- dev.	Post- Incre- ase
<u>I. Minor-Irrigation</u>							
1.	N	162	247	85	131	149	187
2.	NP	122	213	94	140	177	22
3.	NPL	124	253	129	145	216	55
4.	NPR	136	267	131			
5.	D				153	188	36
6.	DP				206	229	36
7.	DPL				173	247	123
8.	DL				197	172	29
9.	L						
Average		132	224	92	150	196	190
<u>II. Mechanization</u>							
1.	MT					141	177
2.	MPT					270	270
Average						193	214
<u>III. Land Reclamation</u>							
1.	RD	114	134	20		162	168
2.	RW	143	179	36			6
3.	RCG	215	264	49	188	259	71
4.	RCW	154	200	46	239	252	13
Average		153	189	36	207	256	49
						187	196
							9

From the study of the table, one could note that no projectwise trend is discernible indicating that farmers take up projects depending only on the actual needs. However, from the table it can be observed that there was an increase in the cropping intensity in all the sample farms after the implementation of the projects except in the case of mechanized farms adopting power tillers.

The changes in cropping intensity as a result of investment in minor-irrigation works were found to be substantial ranging from 85 per cent to 131 per cent in small farms whereas such changes were moderate in medium farms and marginal in large farms.² Considered with changes in land types, as discussed in the preceding section, the substantial changes, in cropping intensity in the small farms could be attributed to cent per cent conversion of dry land into garden land. In other farms such conversion was not noticed.

(iii) Changes in income: Income is an important measure of farm growth. For this analysis net income was computed by deducting the cost of cultivation of crops from the gross value of all the farm produce. The incomes in the pre-development and post-development situations are furnished in Table XIII.

²An exception was noted in large farms where deepening of wells, fitting them with pumpsets and laying pipelines were involved. This would have contributed to substantial improvement in the management of scarce resources to the best extent possible.

TABLE XIII

INCOME IN SAMPLE FARMS IN PRE- AND POST-DEVELOPMENT SITUATIONS

(Rupees)

Sl. No.	Purpose	Small Farms		Medium Farms		Large Farms							
		Pre- dev.	Post- dev.	Pre- dev.	Post- dev.	Pre- dev.	Post- dev.						
		ase	ase	ase	ase	ase	ase						
		Increase	Increase	Increase	Increase	Increase	Increase						
		Percentage	Percentage	Percentage	Percentage	Percentage	Percentage						
<u>I. Minor-Irrigation</u>													
1.	N	4155	6852	2697	64.91	6316	10630	4314	68.30				
2.	NP	3980	8232	4252	106.83	8794	19666	10872	123.62				
3.	NPL	2712	8025	5313	195.91	8171	13943	5772	44.82				
4.	NPR	1604	7211	5607	349.56								
5.	D					16440	20335	3895	23.69				
6.	DP			9290	13250	3960	42.63	27442	32419	18.14			
7.	DPL			12149	16221	4072	33.52	18318	27923	52.43			
8.	DL			7480	16624	9144	122.25	16245	23081	42.08			
9.	L												
Average		3881	7859	3978	102.50	7468	12471	5003	66.99	14419	23763	9344	64.80
<u>II. Mechanization</u>													
1.	MT					47971	62516	14545	30.32				
2.	MPT					38504	40414	1910	4.96				
Average						44184	53675	9491	21.48				
<u>III. Reclamation</u>													
1.	RD	1882	3252	1370	72.79	23062	26686	3624	15.71				
2.	RW	3643	5047	1404	38.54								
3.	RCG	5066	6569	1503	29.67	11147	16338	5191	46.57				
4.	RCW	2696	4365	1669	61.91	14126	16046	1920	13.59	35256	38002	2746	7.79
Average		3242	4714	1472	45.40	12264	16229	3965	32.33	27127	30458	3331	12.28

A perusal of the table will indicate that the net income increased in the post-development stage in all the purposewise groups and sizes of the farms. The percentage of increase in the net income ranged from 4.96 to 349.56. Here also it should be noted that percentage of increase in net income in the minor-irrigation farms, is much higher when compared to mechanized farms and reclamation farms. This clearly establishes the significant role of minor-irrigation in the farm growth. Among the minor-irrigation farms the highest percentage of increase in income was recorded in small size farms implementing new well + pumpset + reclamation (NPL) project.

In the case of mechanized farms, tractor farms recorded the highest change in income i.e., 30.32 per cent and an increase of 4.96 per cent was noticed in the case of farms purchasing power tiller. Though there was no change in the land type and cropping intensity in the power tiller farms there was a change in the income mainly due to savings in labour.

In the case of reclamation farms the highest percentage of income increase was noticed in small farms investing on improvement of dry lands. The enquiry revealed that improvements to dry land were mostly carried out in lands which were hitherto uncultivated and lands which were remaining fallow due to poor soil fertility. These improvements throw open the

possibilities of growing crops like rice and also in some cases facilitate increase in cropping intensity.

Thus, investments on these projects add to the net income. Project for improvement of dry land, with its low investment, offers itself as the first choice for the small farmers because of their limited capital resources and borrowing capacity. From table X (project outlay) it can be noticed that the average investment per farm for reclamation projects is the lowest of all the investments.

(iv) Changes in asset pattern³: This is another indicator of farm growth and development. It also indicates the capital formation in the farms.

The assets of the farms⁴ include buildings, livestock, machinery, equipments and tools. Though machinery, equipments and tools come under the same category, they are differentiated for purposes of analysis because of their different life periods. In this study machinery was defined as those whose life period is ten years, equipments as those whose life period is five years and tools as those whose life period is two years. It may be

³The classes of physical assets such as lands, wells and irrigation structures are not considered here as such assets are reckoned with land types discussed earlier.

⁴The assets are valued at constant prices, based on 1974-75 prices (enquiry period). The changes in the value of assets in the post-development situation therefore reflects the physical changes of assets.

noted that the investments on the assets include borrowed capital and owned capital. The changes in the classwise asset pattern are discussed below.

(a) Buildings: In this study buildings include only those structures which are exclusively used for farming. This has been necessitated because of the peculiarity of the local conditions where buildings are used jointly for residential purposes, store houses, cattle sheds etc.

The change in the building values in the pre and post-development situations are presented in Table XIV.

From the table it can be seen that there was no significant change in the value of the buildings between the two situations except in minor-irrigation farms. The variations in the percentage of building values in the minor-irrigation farms and mechanized farms using tractors ranged from zero to 2000. The highest increase in the building value related to the project NPL. When farmers constructed new wells and installed pumpsets, pumpsheds had to be provided for protection of the machinery. Such pumpsheds often served as a temporary store house of implements and farm inputs. Investments on pipeline varied according to the location of the source of irrigation, scatter of fields and pipe materials used. Along with the installation of pumpset, construction of cisterns and guiding channels were invariably carried out. Thus the wide variations in the building values could be attributed to type of projects

TABLE XIV

VALUE OF BUILDINGS IN THE SAMPLE FARMS IN PRE- AND POST-DEVELOPMENT SITUATIONS

Sl. Purpose/ No. Project	Small Farms			Medium Farms			Large Farms					
	Pre- dev.	Post- dev.	Percentage increase	Pre- dev.	Post- dev.	Percentage increase	Pre- dev.	Post- dev.	Percentage increase			
<u>I. Minor-Irrigation</u>												
1. N	395	395					4450	5950	1500	33.71		
2. NP	804	1804	124.38	1200	2462	1262	4580	6080	1500	32.75		
3. NPL	200	4200	200.00	5475	10475	5000	5175	9175	4000	77.29		
4. NPR	500	1750	250.00				2600	2600	--	--		
5. D				850	1850	1000	4000	5200	1200	30.00		
6. DP				4500	8133	3633	9350	15350	6000	64.17		
7. DPL				1567	9067	7500	5500	15500	10000	181.82		
8. DL												
9. L												
Average	681	1530	849	124.66	1963	4360	2397	122.11	5077	8132	3055	60.17
<u>II. Mechanization</u>												
1. MT							9000	9900	900	10.00		
2. MPT							3445	3445	-	-		
Average							6778	7318	540	7.98		
<u>III. Reclamation</u>												
1. RD	275	275					4800	4800	--	--		
2. RW	500	500										
3. RCG	1500	1500		1500	1500	--						
4. RCW	250	250		2800	2800	--	6500	6500	--	--		
Average	596	596	--	1988	1988	--	5367	5367	--	--		

financed and also level of physical facilities existed prior to the investment.

(b) Livestock: Bullocks are the major sources of motive power in the farms and they are maintained even in farms which have tractors or power tillers as supplementary source of power. This is because some of the cultural practices can be done only by bullock power, and also their dependability in ensuring continuous farming operations. For this analysis, only bullocks were taken into account.

The value of livestock in the farms studied in pre-development and post-development situations are presented in Table XV. The increase in the value represents the addition of livestock strength in the farms.

A perusal of the table will show that there was no change in the value of livestock in small farms, since the existing stock was found to be sufficient to cope up with the farming operations in the post-development situation also. In the medium farms, except in the case of farms undertaking conversion of dry land to garden land projects, there was also no change in the value of livestock between the two situations. In the medium farms undertaking conversion of dry land to garden land projects there was 100 per cent increase in the value of livestock. Conversion of dry land to garden land provides the scope for growing many crops which requires additional motive

TABLE XV

VALUE OF LIVESTOCK IN THE SAMPLE FARMS IN PRE- AND POST-DEVELOPMENT SITUATIONS
(In Rupees)

Sl. No.	Purpose/Project	Small Farms			Medium Farms			Large Farms				
		Pre- dev.	Increase	Percentage	Pre- dev.	Increase	Percentage	Pre- dev.	Increase	Percentage		
<u>I. Minor-Irrigation</u>												
1.	N	790	790	--	1645	1645	--	3025	4025	1000	33.06	
2.	NP	1148	1148	--	1900	1900	--	2630	4030	1400	53.23	
3.	NPL	1000	1000	--	1900	1900	--	3750	3750	--	--	
4.	NPR	500	500	--								
5.	D				1525	1525	--	3100	3100	--	--	
6.	DP							2000	2000	--	--	
7.	DPL				3533	3533	--	1600	1600	--	--	
8.	DL				1566	1566	--	3950	3950	--	--	
9.	L											
Average		1031	1031	--	1816	1816	--	2889	3616	727	25.16	
<u>II. Mechanization</u>												
1.	MT							5200	2000	-3200	61.54	
2.	MPT							2500	800	-1700	68.00	
Average								4120	1520	-2600	63.11	
<u>III. Reclamation</u>												
1.	RD	1200	1200	--				2200	3200	1000	45.46	
2.	RW	1300	1300	--								
3.	RCG	1200	1200	--	1200	2400	100					
4.	RCW	1000	1000	--	2400	2400	--	3500	4100	600	17.14	
Average		1185	1185	--	1650	2400	750	45.46	2633	3500	867	32.93

power. Further, for the process of conversion itself more bullock labour is required. This is the reason for the increase.

In the case of large farms there was an increase in the value of livestock in farms investing on projects like new wells, improvement of dry lands, conversion of dry land to wet land.

The reason for the increase in the livestock value in the reclamation farms, medium and large farms was due to the use of bullock drawn implements exclusively for reclamation work. In addition, for the maintenance of soil fertility and to improve physical condition of soil, tank silt was regularly applied. For the transport of silt from the source to the field bullock drawn carts were used.

The increase in the value of livestock in large farms investing on new well projects was due to the increase in the irrigated area of the farms and the requirement of bullock for lifting out water till installation of pumpsets. This is further supported by the decrease in the value of the livestock noticed in large farms which have invested on new well + pumpset (NP) projects.

With regard to the mechanization project there was a decrease in the livestock value because of substitution of bullocks by machines.

(c) Machinery, equipments and tools: Land development banks finance for machinery and farmers also purchase certain machinery, equipments and tools from out of their own funds for farming. Hence it is necessary to study the change in the values of farm machinery, tools and equipments. This has been discussed by means of two analyses. In one analysis the change in the total value of farm assets comprising machineries, equipments and tools purchased out of borrowed and own funds has been done. In the other analysis the changes in the asset pattern of machinery, equipment and tools purchased only out of own funds have been discussed. This has been done because land development bank finances only for specific machinery, usually those which have the life period of not less than 15 years. However, certain other equipments, tools etc., which are necessary for farming under the changed situation have to be purchased by the farmer.

In Table XVI the change in the value of total machinery, equipments and tools are presented. A perusal of the table will reveal that the total value of the machinery, equipments and tools increased in all the size groups and for all the purposes, except in two cases, namely, improvement of wet land in small farms and conversion of dry land to wet land in medium farms. The highest percentage of increase in the total value of the assets was noticed in small farms investing in NPL and the lowest increase in value was noticed in large farms investing in deepening of well project (D). Within the minor-irrigation

TABLE XVI

VALUE OF MACHINERY, EQUIPMENTS AND TOOLS (TOTAL) IN PRE-, AND POST-DEVELOPMENT SITUATIONS
(in Rupees)

Sl. No.	Purpose/ Project	Small Farms			Medium Farms			Large Farms		
		Pre- dev.	Post- dev.	In- crease	Pre- dev.	Post- dev.	In- crease	Pre- dev.	Post- dev.	In- crease
<u>I. Minor Irrigation</u>										
1.	N	158	870	712			3763	4793	1030	27.37
2.	NP	891	3777	2886	1642	4274	2632	8940	5645	171.32
3.	NPL	327	3397	3070	1695	4579	2884	8444	4653	122.74
4.	NPR	401	2932	2531						
5.	D				1660	4436	2776	6610	82	1.26
6.	DP				3656	3720	64	9980	2564	34.57
7.	DPL				3380	3685	305	8218	5561	209.30
8.	DL							9641	600	6.64
9.	L									
Average		685	3053	2368	1972	4229	2257	7261	3035	71.82
<u>II. Mechanization</u>										
1.	MT							56250	41239	361.40
2.	MPT							19354	13655	239.60
Average								41492	32366	354.66
<u>III. Reclamation</u>										
1.	RD	80	260	180				7219	304	4.40
2.	RW	260	260							
3.	RCG	300	320	20	4860	5480	620	8530	680	8.66
4.	RCW	80	311	231	6400	6400				
Average		179	497	318	5438	5825	387	7656	429	5.94

farms larger changes were noticed in the value of machinery assets in new well group of projects than in farms undertaking projects involving deepening of wells. Even among the farms investing on deepening of wells there were higher changes in farms undertaking deepening projects with pumpsets and pipeline because of acquisition of additional machinery. When farmers undertake only deepening of wells there is no need to go in for additional machinery etc. On the other hand, in the case of new well project where additional area is brought under irrigation, purchase of additional machinery, equipments and tools are necessary. With regard to mechanized farms, as one would expect, there was significant increase in the value. In the reclamation farms the degree of change in the value was not significant except in small farms going in for improvement of dry land and conversion of dry land to wet land which required bullock carts, intercultivation equipments, levelling boards, burmese sattuarn etc.

As noted earlier, the development in the sample farms was financed primarily by the land development bank supplemented by internal capital accumulated through savings. In the preceding paragraphs the overall changes were analysed. It would seem appropriate if the extent of changes attributable to internal financing could be separated and analysed. There exist some methodological issues in separating assets created

by internal financing from bank financing. If a proposed development involves straight forward investment for which inputs are purchased and utilized and if such investments are fully financed by banks, the resultant changes could be attributed to bank financing. Further, if such development generates demand for additional finance to create additional assets which are necessary for intensive farming, and if such additional assets are acquired through internal financing, there can be no difficulty in apportioning changes among both types of financing. However, when both types are mixed, certain judgement is necessary in apportioning the result. In the present case, care was taken to get detailed information on development spending, source of financing and nature of linkages and based on detailed analysis the changes were computed and presented in Table XVII.

As can be seen from the table, there was no change in the percentage increase in value of machinery assets in reclamation farms, as compared to the total machinery assets shown in Table XVI. This clearly indicates that in reclamation farms acquisition of machinery assets was financed by farmers from their savings. This perhaps needs some clarification. It is possible that such purchases can be done directly out of one's saving. Alternatively, a plausible case, the bullock drawn implements could have been purchased out of that portion

TABLE XVII

VALUE OF MACHINERY, EQUIPMENTS AND TOOLS (PURCHASED FROM OWN FUNDS) IN PRE- AND
POST-DEVELOPMENT SITUATIONS

(in Rupees)

Sl. Purpose/ No. Project	Small Farms			Medium Farms			Large Farms				
	Pre- dev.	Post- dev.	In crease	Pre- dev.	Post- dev.	In- crease	Pre- dev.	Post- dev.	In- crease		
			Percen- tage increase			Percen- tage Increase			Percen- tage increase		
<u>I. Minor-irrigation</u>											
1. N	158	870	712	450.63			3763	4793	1030	27.37	
2. NP	891	1277	386	43.32	1642	1774	132	3295	5940	80.27	
3. NPL	327	897	570	174.31	1695	2079	384	3791	5444	43.60	
4. NPR	401	432	31	7.73							
5. D					1660	1936	276	6528	6610	82	
6. DP								7416	7480	64	
7. DPL					3656	3720	64	2657	3218	561	
8. DL					3380	3685	305	9041	9641	600	
9. L											
Average	685	1134	449	65.55	1972	2158	186	4226	5935	1709	40.44
<u>II. Mechanization</u>											
1. MT								11411	13650	2239	19.62
2. MPT								5699	7154	1455	25.53
Average								9126	11052	1926	21.10
<u>III. Reclamation</u>											
1. RD	80	260	180	225.00				6915	7219	304	4.40
2. RW	260	260	0	0							
3. RCG	300	320	20	6.67	4860	5480	620			12.76	
4. RCW	80	311	231	288.75	6400	6400	0	7850	8530	680	8.66
Average	179	284	105	58.66	5438	5825	387	7227	7656	429	5.93

TABLE XVII(a)

VALUE OF MACHINERY, EQUIPMENTS AND TOOL
PURCHASED AFTER THE INVESTMENT

(in Rupees)

Sl. No.	Purpose/Project	Small Farm	Medium Farm	Large Farm
<u>I. Minor Irrigation</u>				
1.	N	212	-	2530
2.	NP	386	394	4045
3.	NPL	570	1384	1653
4.	NPR	1281		
5.	D			82
6.	DP		276	64
7.	DPL			561
8.	DL		168	600
9.	L		305	
Average		391.44	466.66	2481.36
<u>II. Mechanization</u>				
1.	MT			-
2.	MPT			-
<u>III. Reclamation</u>				
1.	RD	180	-	1604
2.	RW	-	-	-
3.	RCG	20	1820	-
4.	RCW	230	-	280
Average		105.00	1137.50	1162.67

of bank funds ear-marked to defray transport costs. Considering the opportunity cost of hiring machinery, it can be reckoned for internal financing.

Only in small farms investing on improvement of dry lands and converting dry land to wet land there was a considerable increase in the value of machinery assets. When dry lands were improved the area under dry crops were replaced by irrigated crops for which specialized implements and tools were necessary. These equipments were easily acquired by the farmers from their own funds. Similar changes were also noted when conversion of dry land to wet land was done. In such cases farmers had to invest on machinery and tools like burmese satturn, leveller, sickles etc., which were within their reach.

In mechanized farms there was a change in the value of assets ranging from 20 to 26 per cent. Whenever farmers acquired tractor or power tiller they had to necessarily purchase some additional equipments which resulted in higher asset value.

In minor-irrigation farms there was large increase in asset value in small farms implementing new well project, as by sinking new wells, dry lands were newly brought under irrigation and the farmer had to purchase implements necessary to cultivate the irrigated crops. It may be recalled that in these small farms changes in land types were cent per cent.

In the medium farms the changes in the assets were not well pronounced. This indicated that the assets already possessed by this group of farmers were sufficient even if additional areas were to be brought under irrigation. In large farms the increase was higher than in the medium farms. Eventhough the value of assets already possessed by the large farms were greater than the medium farms they were just sufficient to cultivate the existing area.

(v) Changes in working capital: Having discussed the changes in the fixed capital position in the pre-development and post-development situations it is necessary to study the increase in the demand for working capital due to the development that have taken place in the farms. The working capital included the cultivation expenses of crops, maintenance charges of farm bullocks, annual repairs to implements and farm buildings and expenses on taxes and temporary dead stock. The working capital requirements in pre-development and post-development situations are given in Table XVIII.

The study revealed that there was an increase in working capital requirements in all the farms except in farms implementing the project purchase of power tiller where the change was negative. In general, the increase in working capital was found to be high in minor-irrigation farms and the highest change was 244.85 per cent noticed in small farms implementing

TABLE XVIII

AMOUNT OF WORKING CAPITAL REQUIRED FOR COST OF CULTIVATION OF CROPS AND MAINTENANCE OF LIVESTOCK
IN PRE-, AND POST-DEVELOPMENT SITUATIONS

Sl. No.	Purpose/ Project	Small Farms			Medium Farms			Large Farms			Percent- tage increase	
		Pre- dev.	Post- dev.	In- crease	Pre- dev.	Post- dev.	In- crease	Pre- dev.	Post- dev.	In- crease		
<u>I. Minor-Irrigation</u>												
1.	N	4966	7648	2682	11033	16367	5335	16614	27290	10676	64.26	
2.	NP	5005	10918	5913	11826	19433	7607	24615	40672	16057	65.23	
3.	NPL	4405	10982	6577	11826	19433	7607	33194	46009	12815	38.61	
4.	NPR	2145	7397	5252								
5.	D				13370	17499	4129	20288	24938	4650	22.92	
6.	DP				20910	25777	4867	29283	35064	5781	19.74	
7.	DPL				15687	22324	6637	26064	37527	11463	43.98	
8.	DL							19518	26655	7137	36.57	
9.	L											
Average		4849	9995	5146	12636	18164	5528	25131	37896	12765	50.79	
<u>II. Mechanization</u>												
1.	MT							105361	129461	24100	22.82	
2.	MPT							40380	35670	-4710	-11.66	
Average								79369	91945	12576	15.84	
<u>III. Reclamation</u>												
1.	RD	4031	4485	454	14994	23571	8577	23148	23408	260	1.12	
2.	RW	5762	6737	975	19544	20551	1007					
3.	RCG	8624	10381	1757								
4.	RCW	5444	5449	5								
Average		5813	6598	786	16700	22439	5739	34.37	25798	26378	580	2.25

the project NPR and the least change i.e., 0.09 per cent was found in small farms implementing project converting dry land to wet land. A comparison of changes in working capital requirements with the increase in cropping intensity revealed that there was no significant correlation between the two. This indicated that the working capital requirement might probably be related to the 'shifts' in cropping pattern rather than in the cropping intensity. Working capital requirement was much less for dry crops. Further in dry lands only one crop was raised in a majority of the cases and when these lands were converted into irrigated lands the working capital requirement increased substantially.

In the project for use of power tiller (MPT) the cropping pattern did not change much and the decrease in the working capital was due to the decrease in the maintenance cost of the bullocks, displaced due to mechanization.

(vi) Changes in cropping pattern: Cropping pattern is an important factor influencing the farm income. The objective of the farmer is generally to decide on the optimum crop mix in his farm for maximising his income. The cropping pattern adopted in the pre-development and post-development situation in each of the project is presented in Appendix B.1 to B.26 and abstracted in Table XIX.

TABLE XIX

CROPPING PATTERN ADOPTED IN PRE-DEVELOPMENT AND POST-DEVELOPMENT SITUATIONS

Particulars	Situation	Area under crops (hectares)					
		Rice		Groundnut		Ragi	
		Total to total area cropped area	Per cent to total cropped area	Total to total area cropped area	Per cent to total cropped area	Total to total area cropped area	Per cent to total cropped area
<u>Minor Irrigation purposes</u>							
Small Farms	Pre-dev.	1.36	73.51	0.36	19.46	0.13	7.03
	Post-dev.	2.17	68.67	0.99	31.33	-	-
Medium Farms	Pre-dev.	2.71	64.68	1.19	28.40	0.24	5.73
	Post-dev.	3.95	72.74	1.48	27.26	-	-
Large Farms	Pre-dev.	8.45	80.55	1.72	16.40	0.32	3.05
	Post-dev.	9.63	72.35	3.22	24.19	0.46	3.46
<u>Mechanization purpose</u>							
Large Farms	Pre-dev.	18.64	74.68	6.32	25.32	-	-
	Post-dev.	21.47	68.31	9.96	31.69	-	-
<u>Reclamation purpose</u>							
Small Farms	Pre-dev.	8.93	67.24	3.88	29.22	0.47	3.54
	Post-dev.	9.50	70.79	3.11	23.17	0.81	6.04
Medium Farms	Pre-dev.	4.66	77.67	1.34	22.33	-	-
	Post-dev.	5.66	75.77	1.81	24.23	-	-
Large Farms	Pre-dev.	1.17	72.22	0.41	25.31	0.04	2.47
	Post-dev.	1.54	77.78	0.37	18.69	0.07	3.54

Rice, groundnut and ragi were the three crops grown in the sample farms. Rice and groundnut were grown both in dry land and irrigated conditions and in all the three types of lands, wet, garden and dry. Rice was grown in all the three seasons, while groundnut was limited to first and third seasons only.⁵ In the second season rice alone was grown in wet lands and in dry lands. Ragi was grown in the second season only.

The area of rice in absolute terms that is in hectares increased in all the minor-irrigation farms and in all sizes of farms. However, the relative importance of rice in the cropping pattern, the rice area being expressed as percentage to total cropped area, revealed a mixed trend among the size of farms. As could be seen from the table that the percentage had declined in small and large farms and increased in medium farms. In the case of groundnut the absolute area increased in all cases of minor-irrigation farms. However, in percentage terms the direction of changes was just opposite to that of rice showing the substitutability of rice for groundnut and vice versa.

It is interesting to note that ragi crop grown in dry lands before development was completely replaced by irrigated crops such as rice and groundnut in small and medium farms. A marginal increase in area under ragi was noticed in large farms.

⁵The seasons are classified as follows:
 Season 1 - July to October
 Season 2 - November to February
 Season 3 - March to June.

As regards mechanized farms the area under rice and groundnut increased though in percentage terms the former declined while the latter increased.

In reclamation farms the area under rice increased in all size farms. But the per cent of rice area to total cropped area increased in small and large farms while declined in medium farms. The area under groundnut decreased in small and large farms with decreasing percentage also, whereas in medium farms both area and percentage showed an increase. As regards ragi it was found that both area and percentage increased in small and large farms.

One could infer from the foregoing analysis of trend in absolute area and percentage with reference to individual crops that the substitution possibilities between rice and groundnut ~~and~~ ~~ground~~ crops grown under irrigated conditions during first and third season. The crops like ragi mainly grown under rainfed condition in dry lands would tend to be replaced by irrigated crops whenever irrigation facilities are augmented through investments in minor-irrigation and reclamation projects. The range and degree of substitution would depend on relative prices and resource availability.

To test whether the changes in the cropping pattern were statistically significant or not rank correlation was applied. Crops grown in small, medium and large farms in all the projects were grouped separately for pre-development and post-development

situations. The percentage area of each crop to the gross cropped area was worked out and ranks were assigned on the basis of their percentage. Then rank correlation co-efficients were worked out for the cropping patterns in the two situations for small, medium and large farms separately as given in Appendix B Tables 27 to 29. The results of the analysis indicated that there was a significant change in the cropping pattern between pre-development and post-development situations.

From the discussions so far made it can be concluded that the land development banks' finance for the implementation of minor-irrigation, mechanization and land reclamation projects has influenced the land use pattern, cropping intensity, cropping pattern, asset pattern and working capital requirements and income levels. Since there is a positive influence in all these parameters it can be stated that the land development banks' finance contributes to the growth and development of the farms.

D. Capital Budgeting

(i) Concepts and assumptions

Capital budgeting has been adopted in the study as a method for evaluating investment expectations. Of the various criteria available for such evaluation the IRR criteria was selected for the present study. Data on the returns, and the capital and maintenance costs over a period of years, as explained in the following paragraphs, were collected from the sample farms for pre-development and post-development situations.

From the data of actual costs and returns, the anticipated costs to be incurred and expected returns likely to be earned every year for the cash flow period considered were computed.

In working out the costs, all the capital as well as current expenditures were taken into account and the returns were calculated on the basis of the cropping pattern and value of the produce from the crops included. The details of costs and returns were worked out for 20 years for the minor-irrigation farms, 10 years for the mechanized farms and 15 years for the reclamation farms. For the former two cases the periods considered represent the life period of the projects and for the latter (reclamation purpose) the life period criterion would not be relevant. When once improvements like levelling and bunding were carried out there was no replacement except incurring cost for maintenance of the improvements done in the later years. The period considered, for the analysis, for reclamation purpose, therefore corresponded to the loan amortization period.

In working out the costs and returns the prices of inputs and products were assumed to be invariant throughout the period considered, interest and depreciation were not included in the cost, however, the interest on borrowed capital paid to the lending institution was included. Depreciation was not included because it was assumed that the

total capital was used up at the end of the project operation, except for some salvage value which was treated as project benefit in the last project year.⁶ As explained earlier, there were some associated investments. These investments were also considered as the cost and hence their replacement and maintenance were also included under cost. In addition, all the assets like buildings exclusively used for farming, machinery, equipments and tools were also considered in the cost. In computing cost of cultivation of crops all the expenditure incurred for the cultivation of crops were taken into account. In this, family labour used for cultivation was valued at market wages and computed as cost. Farm bullock labour was excluded in the cost of cultivation but the expenses on their annual maintenance were considered.

The returns constituted the value of all the products received from the crops cultivated in the farm and value of custom service, manures and terminal value or salvage value of the assets.

It was assumed that all the investments and other costs were incurred at the beginning of the year and returns were earned at the end of the year. It was also assumed that all

⁶J.Price Gittinger, Economic Analysis of Agricultural Projects, (London: The Johns Hopkins University Press, 1972) pp.85-87.

the farm investments were made in the first year. The flow of the benefits varied for different purposes. In the present case benefits of the project, were assumed to flow from the second year in the case of MI projects, and from the first year in the case of mechanized farms. In reclamation farms the benefits start flowing from the second year, but the flow is steady only from the third year.

Complete farm budgets were worked out and used for preparing the cash flow statements for pre-development and post-development situations. From the cash flow statement the incremental costs and returns for the different years were calculated. The balance of these costs and returns were considered to be the ultimate or net cash flows of costs and returns of the project due to the investments. The IRR was calculated from the net cash flows.

By definition the IRR is that discount rate which makes the present value of cost equal to the present value of returns. That is

$$\sum_{n=1}^N \frac{C}{(1+r)^n} = \sum_{n=1}^N \frac{R}{(1+r)^n}$$

$$\sum_{n=1}^N \frac{R - C}{(1+r)^n} = 0$$

Where R - the returns in each year

C - the cost in each year including investment

R- C - Net cash flow of the costs and returns

N - Number of years (1, 2, 3,.....N)

r - discount rate

The value of net cash flow was worked out for different values of 'r'. Then the appropriate IRR was determined by approximation method.

The cash flow statements and the working of IRR are presented in Annexure C. The IRR thus worked out for all the projects are given in Table XX.

A study of the table will reveal that, for a given project, the IRR increased as the size of the farm increased. This indicated that large farms realised higher profits. The higher rate of returns, in combination with the greater project outlay, provided a high net value of earnings, for the large farms. For example, in the project NP, the IRR was 30.16 per cent in small farms, 33.10 per cent in the medium farms and 58.11 per cent in the large farms. Investments amounted to Rs.8,000, Rs.8,500 and Rs.9,750, respectively. Increases in the post-development income over the pre-development income were Rs.4,252, Rs.5,597 and Rs.10,872, respectively.

TABLE XX

IRR OF THE PROJECTS IDENTIFIED IN THE SAMPLE FARMS

Sl. No.	Projects	Internal Rate of Return in		
		Small	Medium	Large
<u>I. Minor-Irrigation</u>				
1.	New well	30.34	--	35.34
2.	New well + Pumpset	30.16	33.10	58.11
3.	New well + Pumpset + Pipeline	22.65	29.11	51.48
4.	New well + Pumpset + Reclamation	43.75	--	--
5.	Deepening + Pumpset	--	--	47.52
6.	Deepening + Pumpset + Pipeline	--	37.24	37.25
7.	Deepening + Pipeline	--	--	31.34
8.	Deepening + Pipeline	--	20.83	30.60
9.	Pipeline	--	43.09	--
<u>II. Mechanization</u>				
1.	Tractor	--	--	27.05
2.	Power Tiller	--	--	<0
<u>III. Land Reclamation</u>				
1.	Improvement of dry lands	26.35	--	32.73
2.	Improvement of wet lands	29.90	--	--
3.	Converting dry lands to garden lands	31.03	41.54	--
4.	Converting dry lands to wet lands	25.80	32.31	37.22

The increase in income per rupee investment thus worked out to Rs.0.53, Rs.0.54 and Rs.1.12 in small, medium and large farms respectively indicating the higher benefits derived by the large farms.

Further increase in income was higher wherever dry lands were converted into irrigated lands. In small farms the extent of dry land was much less than in the medium and large farms. The average dry land area in the small farm was 0.86 ha as compared to 1.37 ha in medium and 2.76 ha in the large farm. Out of this area 0.86 ha, 1.03 ha and 1.36 ha of dry lands in small, medium and large farms respectively were converted into irrigated lands. This was also one of the reasons for lower IRR in the small farms.

The IRR in all the projects were higher than the institutional lending rates of interest viz., 11 per cent except for the project purchase and use of power tillers (MPT). Hence farmers can take up these projects for improving their farm income. From the enquiry it was reported that the interest rates charged by the private village money lenders were as high as 36 per cent. At this high rate of interest most of the projects are not profitable especially for the small farms.

As expected no trend could be noticed in the IRRs between the purpose for which loans were availed. Each purpose had its own profit dimension and there could not be any

substitution and the selection of the purposes had to be based on the needs of the farms. Both the highest and the lowest IRRs were realised in the minor-irrigation purpose: the highest 58.11 per cent was noted in large farms implementing NP project, the lowest 20.83 per cent was noticed in medium farms, implementing the project DL. Negative returns were realised in the large farms implementing the project MPT.

The IRR depends on the project outlay and the associated costs on the one hand and the returns influenced by the changes in land type, cropping pattern and cropping intensity on the other hand.

The IRRs for different projects in minor-irrigation, mechanization and reclamation purposes are discussed below.

(ii) IRR in minor irrigation farms

As explained earlier the projects in the minor-irrigation farms may be categorised under the two broad groups viz., new well projects and deepening projects. Out of the four new well projects in the small farms the project NPR yielded highest IRR and the project NPL the least IRR. Considering the three new well projects viz., (i) N, (ii) NP, (iii) NPL negative relationship was noticed for project outlay and rate of return. As regards sizewise differences, the IRR was higher in the large farms than that of small farms. This difference particularly for investment on new wells would seem to have policy implications on bank lending policy.

For a small farm say, less than one ha, a well dug with an outlay of Rs.6000 might be too expensive in terms of its utilization. In other words possibility of excess capacity could have existed as seen in arrangements for selling surplus water in a number of farms. Recently the Government have encouraged the formation of 'Small Farmers' Lift Irrigation Co-operative Societies'. Loans are issued to them for digging wells in a place acquired by the society and for pumpsets and other assets. The water is shared among the members on an agreed pattern. The number of wells to be owned are determined according to the groundwater potential and the area pooled for the society. These societies thus ensure rational use of water and minimize the operational and fixed overhead costs. This arrangement of common ownership and joint operation resolves many problems of lumpiness and excess capacity of resources developed through investment by land development banks.

On the other hand, in large farms adequate lands were available and with suitable cropping plans they could exploit the available water from wells to the fullest extent resulting in substantial reductions in overhead costs per unit. It follows that the question of optimal investment design for small farms and large farms with specific reference to resource base, particularly land, would maximize the return on investment. The problem has gained greater significance

because of current concern about energy crisis and management of ground water at the optimum level.⁷

Looking from different angle, one would insist that, managing the ground water apart, the incremental income generated could be crucial for small farmer development. The increase in income per farm during post-development period over that of pre-development was estimated to be Rs.3979 and Rs.9344 in small and large farms, respectively. Low IRR might reflect on investment efficiency but larger quantum jump in income could lead to land consolidation and land transfers which would ultimately result in better management. Viewed in this manner the problem would involve long-term adjustments. Nevertheless, such an approach need not be inconsistent with efficiency approach and the latter entails ultimately stability in resource supply over time, perhaps generations.

The new well (N) project envisages the traditional method of lifting water with bullock power and such method would command an area of about one hectare. The commanding area was limited because of the capacity of the bullock power, rather than the water potential. However, in this project also,

⁷Robert Chambers "Population, Energy and water: a Design for a Possible Future for Part of an Indian District" Centre of South Asian Studies, Cambridge University, December, 1974 and "The Planning of Technologies for Future Population" mimeographed (Sussex: The Institute of Development Studies, 1975) pp.5-6.

the IRR in large farms were higher than in the small farms. A closer examination would reveal that small farms adopting this project operated on an average 0.87 ha wet lands and 0.24 ha dry lands whereas large farms had 3.82 ha of wetlands and 1.72 ha of dry lands. The scope for increasing cropping intensity in wet lands were much less than in dry lands converted into irrigated lands and since rate of conversion of dry land to garden land was more in large farms, there was higher rate of returns.

In the small farms the IRR was high in the project NPR. In the reclamation projects, the productivity of the land was also increased in addition to the other benefits secured from NP project. In this case, dry lands, not hitherto cultivated were brought under cultivation, thereby increasing the income many fold.

Deepening of well projects were undertaken to augment the water potentiality in medium and large farms only. The deepening of well projects were not undertaken in small farms. This indicates that the water potential as existed in the small farm was sufficient to command the entire area of the small farms. Since there was scope for increasing the capacity of the wells and consequently the irrigated area, deepening of well projects were undertaken by medium and large farms only.

In the sample farms investment in projects for laying pipe line (L) were made by medium farmers only. Among all the

projects undertaken in the medium farms, the pipeline project yielded the highest IRR. The pipeline projects were mainly undertaken to convert the dry lands which were at higher level or a fragmented piece situated in a distant place. For a comparatively lesser project outlay, 0.95 ha of single crop dry land was converted into three crop garden land, thus explaining the reason for the higher IRR. However, there was no need for all the farmers to lay pipe lines. This project is possible only where the conditions warrant.

(iii) IRR in mechanized farms

Purchase of tractors is beneficial to the farmers in three ways. It increases the cropping intensity in the farms. In the traditional method of preparing the land, by using bullock power, the coverage per day is less and therefore the desired area could not be covered in time. This entails loss of time and less area under a given crop than that is possible by mechanical power. Secondly, tractor increases the yield by helping timely sowings with critical moisture level. It also displaces bullock labour the maintenance of which, in recent times, is posing problems to the farmers. The large farmers had to leave approximately 3.00 ha or 17 per cent of total area of land as fallow, as they could not prepare their lands in time with bullock power.

The IRR for tractor project (P) was somewhat low and a study of the cash flow statement would reveal that a sizeable portion of profit was contributed by custom service. In the

absence of scope for custom hire and suboptimal size of holding this project would result in negative returns to the farmers under the conditions prevailing in the project area. Further more, cost of maintenance, repairs and upkeep showed steep increase after fifth year. It would, therefore, seem necessary that for a positive and profitable returns from tractor project, the operated area of the farm should be larger and there should also be scope for earnings through custom service.

The project, purchase and use of power tillers (MPT) was undertaken by farmers having an average area of 7.98 ha, as against 17.70 ha for tractor farms. These were irrigated farms with limited scope for increasing the cropping intensity. Custom hiring was also not possible because custom hiring of power tiller equipment was not preferred. The only advantage was that the farmers could dispose off the bullocks, the maintenance of which was expensive in these farms. Because of high cost of maintenance, repairs and upkeep of power tillers and the near zero opportunity cost, particularly in the absence of demand for custom service, the project yielded negative returns. However, farmers had invested in power tillers probably due to the need for substitution of permanent labour and bullock labour, suboptimal size of their holdings and personal preferences for tractors.

(iv) IRR in reclamation farms

Among the reclamation projects the lowest IRR was

noticed in conversion of dry land to wet land i.e., 25.80 per cent and the highest IRR 41.54 per cent was noticed in project involving conversion of dry land to garden land. Of all the reclamation projects conversion of dry lands to wet lands and conversion of dry lands into garden lands appeared to be more profitable proposition. It could also be seen from the Table XX that in large farms, converting dry land to wet land, yielded higher rate of returns, whereas in small farms this project yields were comparatively less, the reason being that the investment per unit area of land benefited was less in the small farms than in the large farms. The average investments in project was Rs.3,800 in the small farms and Rs.5,000 in the large farms and the area converted was 0.36 ha in small farms and 0.42 ha in the large farms.

Eventhough the project cost of converting the dry land to garden land was the highest, i.e., Rs.6,500, the IRR was also the highest i.e., 41.54 per cent, among the reclamation projects. The area converted was 0.75 ha which is also high. This type of reclamation was a condition for shifting dry land cultivation to irrigated agriculture where lands were made fit to use irrigation water. In a way it was a supplementary investment for minor-irrigation purpose. However, this type of projects were possible only when there was surplus water available in the farms which could be diverted to these lands.

E. Optimum Crop Plans

i) Specification of linear programming model

One of the objectives of the study was to examine the existing enterprise-mix and to determine the optimum enterprise-mix in the pre and post-development situations, by adopting linear programming technique. Considering the magnitude and the number of loans availed by the farmers and the additional returns produced in the farms minor-irrigation projects were found to be highly significant for farm development. The present part of the analysis therefore covers minor-irrigation projects only.

(a) Identification of situations

The study envisages comparison of optimum plans for the pre and post-development situations; one with the existing resources in the farm in the pre-development period and another with added resources, due to investment in resource development in the post-development period. Since it was found in the earlier part of the analysis that the size of farms also had influence on the returns the optimum plans were formulated for the following six specified situations for detailed analysis.

1. Small farms in the pre-development situation
2. Small farms in the post-development situation
3. Medium farms in the pre-development situation
4. Medium farms in the post-development situation
5. Large farms in the pre-development situation
6. Large farms in the post-development situation.

(b) Formation of the technological matrix

Any linear programming model has three components viz., (a) a structure of constraints, (b) an activity set and (c) an objective function. These components are discussed below.

(c) The structure of resource constraints

The enterprise-mix of the sample farms were restricted by the following constraints.

1. Agricultural land

Availability of operational land was a major constraint that influenced the acreage decisions for different crops on the farm firm. In the short run, it was assumed, that the operational holding could not be increased either by purchase or by taking additional area on lease. Thus the limited area was to be allocated, consistent with other limiting resources, among enterprises for maximising the income.

Land type, based on the irrigation facilities, greatly influenced the choice of the crop enterprises and farmers' allocative decisions. Therefore, as specified earlier⁸ the three land types viz., wet land, garden land and dry land were considered separately as input constraints.

Further, there was a seasonal constraint of the lands imposed by the adoptability of crops to specific season. Since the crop enterprises had been considered individually

⁸See page 102

seasonal opportunities for multiple cropping had to be created. Such a contingency warranted consideration of land area on a seasonal basis and accordingly wet, and garden lands were classified into three seasonal lands and dry land was classified into two seasonal lands.

To specify the level of land resources available, net cultivable area in sample farms in each size group was pooled and averaged. The land area available for cultivation under different groups of farms are given in Table XXI.

2. Agricultural labour

The availability of agricultural labour was another important constraint especially during peak labour demand months. In the study area family labour, permanent labour and hired labour constituted the labour structure of the farms. All these categories of labour were considered for identifying labour restrictions. A day with eight hours of work was considered as an unit (Manday). Women labour had been converted to man equivalents at the rate of three women per two men on the basis of differences in wages.

Data on agricultural labour population was collected from taluk labour records. The total available labour was equally divided among the net area cultivated in the taluk. The availability was weighted with the weekly and other religious holidays.

TABLE XXI

LAND TYPE AND NET CULTIVABLE AREA IN SIX PROGRAMMING SITUATIONS

(hectares)

Land type	Pre-development situation			Post-development situation		
	Small farms	Medium farms	Large farms	Small farms	Medium farms	Large farms
Wet land	0.51	1.48	3.83	0.51	1.48	3.83
Garden land	--	--	0.37	0.74	1.02	1.61
Dry land	0.74	1.37	2.86	--	0.35	1.62
Total	1.25	2.85	7.06	1.25	2.85	7.06

The demand for agricultural labour depended upon the cropping pattern, intensity and time distribution of agricultural operations and the mode of agricultural technology. As a result, the time distribution of demand for labour varied. As different crops had different critical periods of labour requirement, the time distribution of labour demand assumed greater relevance. The labour requirement on the selected farms was compiled groupwise on the basis of their monthly requirements and periods with high labour requirements were identified as critical periods. Based on the cropping seasons of the existing crops the critical periods were identified as given in Table XXII.

3. Capital

Capital was required for the purchase of factors of production. Capital availability in the farms was estimated taking into consideration the income from all sources and the expenses on cultivation of crops and consumption and other miscellaneous expenses in the farm both in kind and cash.

It was found from the enquiry that the farmers' own capital consisted, of the balance of profits of the previous year after deducting the family consumption and quantum of short-term loan he could borrow. The capital availability in different sizes of farms during the pre and post-development situations are given in Table XXIII.

TABLE XXII
 AGRICULTURAL LABOUR IN SIX SITUATIONS

Labour(Months)	(Mandays)					
	Pre-development situation			Post-development situation		
	Small farms	Medium farms	Large farms	Small farms	Medium farms	Large farms
Labour July	42.50	71.55	187.50	42.50	71.55	187.50
Labour Nov.	42.50	71.55	187.50	42.50	71.55	187.50
Labour April	--	71.55	187.50	42.50	71.55	187.50

TABLE XXIII
CAPITAL AVAILABILITY IN SIX PROGRAMMING SITUATIONS

(in Rupees)

Particulars	Pre-development situation			Post-development situation		
	Small	Medium	Large	Small	Medium	Large
Working capital	1750.00	4500.00	12500.00	3500.00	7500.00	18000.00

4. Irrigation water

The influence of irrigation has been adequately brought out in the preceding part of this study. In the area studied tanks and wells were the main sources of irrigation. The availability of water decided the acreage allocation under different crops. Tank water was restricted to about five to nine months according to the quantum of monsoon rains of the year from tank irrigation. Wells were dug in wet land to stabilise the water position for the cultivation of crops with tank irrigation and to cultivate a third crop during summer season, solely irrigated by well water. Wells dug in dry land converted the land into garden land thereby facilitating the farmer to take two or three crops in a year, depending upon the water level in the wells which was again influenced by the rainfall of the year.

As in the case of labour, the seasonal requirements of irrigation for different crops were estimated. In order to identify the peak periods of irrigation requirements, which influence acreage allocation under different crops, monthly requirements of water for the selected crops and land classes were estimated.

Periods of irrigation restriction and the availability of water in different groups of farms in six programming situations are given in Table XXIV.

TABLE XXIV
IRRIGATION WATER AVAILABILITY IN SIX PROGRAMMING SITUATIONS
(in acre inches)

Resteering months	Pre-development			Post-development		
	Small	Medium	Large	Small	Medium	Large
Water June	---	15.00	30.00	30.00	35.00	60.00
Water April	---	10.00	22.50	22.50	27.00	45.00

(d) Activity set

The activity set in this part of analysis is formed of only production activities consisting of crops only. The subsidiary occupation in farms namely, livestock and poultry enterprises were not adopted on a large scale in the area studied and hence they were not included in the set. All the crop activities that were grown in the sample farms were included in the activity set and no new crop enterprises were added.

The crops selected for programming and their seasons are discussed below.

There are three well defined seasons in the study area and crops are grown to commensurate with these seasons.

The three seasons are:

<u>Season</u>	<u>Months</u>	<u>Monsoon influencing crop growth</u>
1	July to October	South-West monsoon
2	November to February	North-East monsoon
3	March to June	Hot-weather

The crops grown in three types of lands are as follows:-

(i) Wet land

<u>Crop</u>	<u>Dry/Irrigated</u>	<u>Variety</u>	<u>Season</u>
Rice	Dry + Irrigated (D + I)	Local	1
Rice	Irrigated (I)	Local	1
Rice	Irrigated	HYV ⁹	1
Groundnut	Irrigated	Improved	1
Rice	Irrigated	Local	2
Rice	Irrigated	HYV	2
Rice	Irrigated	Local	3
Rice	Irrigated	HYV	3
Groundnut	Irrigated	Improved	3

In the wet land crops were grown with flow irrigation available from the tanks. Water from tanks was available for varying periods from four to nine months depending upon the monsoon rains. Assured water supply from tanks was available for growing rice in the second season. In the first season, if the monsoon was favourable, water was drawn from tanks for the cultivation of an irrigated crop. If sufficient water was not available in the tanks, a portion of the land was cultivated with irrigated crop and a portion sown as dry crop to start with and, later on when tanks get filled up, they were converted as irrigated crop. This is noted as Dry + Irrigated, above.

⁹HYV denotes High Yielding Variety.

If wells were available in the wet lands, irrigated crops could be grown in season 1. Tank water was normally not available in season 3. Hot weather period rains was also insufficient to raise dry crops. Therefore in season 3 crops in wet lands could be grown only with well water.

(ii) Garden land

<u>Crop</u>	<u>Dry/Irrigated</u>	<u>Variety</u>	<u>Season</u>
Rice	Dry	Local	1
Groundnut	Dry	Improved	1
Groundnut	Irrigated	Improved	1
Rice	Irrigated	Local	1
Rice	Irrigated	HYV	1
Rice	Irrigated	Local	2
Rice	Irrigated	HYV	2
Rice	Irrigated	Local	3
Rice	Irrigated	HYV	3
Groundnut	Irrigated	Improved	3

As explained earlier, garden lands were irrigated only by wells. There was an assured water supply from wells in the second season and therefore irrigated crop of rice was grown in this season. It is to be pointed out that due to heavy rainfall and inundation of fields no other crop except rice can be grown in this season. In season 1, if enough water was

available in the wells, rice or groundnut was grown as irrigated crop. If enough water was not available for irrigating the entire farm area, a portion was grown as dry crop. Varieties of rice suited to irrigated and dry conditions were separate. Some of the groundnut varieties were grown both under dry and irrigated conditions. The proportion of irrigated crop in the first season, therefore, depended on the proper assessment of water potential in the wells. In wet land dry crops cannot be grown in season 3. Therefore the area under irrigated crops in season 3 also depended on the availability of water in the wells. Since water requirement varied from crop to crop and variety to variety the problem of allocation of resources became complex.

(iii) Dry land

The following crops were grown under dry condition.

<u>Crops</u>	<u>Irrigated/Dry</u>	<u>Variety</u>	<u>Season</u>
Rice	Dry	Local	1
Groundnut	Dry	Improved	1
Ragi	Dry	Local	2

In lands having gentle slope rice was grown as dry crop. In undulating terrain groundnut was cultivated. Groundnut does not perform well during periods of heavy rainfall and/or under inundated conditions. Farmers, therefore, preferred to grow rice in level lands under dry conditions and groundnut in

undulated lands. Levelling and land reclamation works were taken up by the farmers so that the land could be made fit for the growth of rice crop. Ragi was grown in season 2. It was also mixed with groundnut in the first season to hedge against risks in the cultivation of groundnut.

(e) Technological matrix

The input coefficients required to produce one unit of each activity, were estimated on the basis of information collected from the sample farms and by averaging the data from all the farms falling under a size group. The input co-efficients used in the technological matrices of the six programming situations are given in Appendix D, Tables 1 to 6.

(f) Net value product for the activity set

Prices of the product from each activity were used to compute the farm's net income per unit of the activity. In the present problem, it denotes the net value product 0.4047 ha (equivalent to one acre) of the crop activity. This measure includes three variables i.e., (i) the prices of the product, (ii) the yield, and (iii) cost of cultivation of crops. Variations in any of these affected the net income of the activities. Farm gate prices were considered for valuing the farm products. Net income (per unit area) of each crop in each of the farm surveyed was worked out separately for each group and they were pooled and averaged for each activity.

(g) The objective function

The objective function for this part of analysis was assumed to be maximizing the net income in the farms. The linear objective function of this model can be expressed as

$$\text{Maximize } Z_0 = C' X$$

Subject to

$$AX \leq b$$

$$X \geq 0$$

Where C: $n \times 1$ Vector of net value product of crop activities

X: $n \times 1$ Vector of crop activities

b: $m \times 1$ Vector of resource levels

A: $m \times n$ matrix of technical coefficients.

The simultaneous equations formed in the model were solved by simplex method of successive approximation. The 'initial tableau' formed under six programming situations are given in the Appendix D. The programmes were run in IEM 1620 Model II Computer. The results of the programme are given in Appendix E.

ii) Discussion of linear programming results

As the objective of this analysis was to determine the optimum crop-mix, it was necessary that the linear programming solutions should be evaluated in terms of existing cropping patterns. The optimum plans, were therefore, compared with

the existing plans with reference to income, cropping pattern and resource use efficiency. The results are presented below.

(a) Income

In Table XXV the income of the optimum plans for the two situations are compared with the income of the existing plans.

TABLE XXV
COMPARISON OF INCOME FROM OPTIMUM PLANS WITH EXISTING PLANS
IN PRE AND POST-DEVELOPMENT SITUATIONS

Farm size	Income in pre-development situation			Income in post-development situation		
	Exist- ing plan	Optimum plan	Percentage increase over exist- ing plan	Exist- ing plan	Optimum plan	Percentage increase over exist- ing plan
	Rs.	Rs.		Rs.	Rs.	
Small	2937	2982	1.53	5057	5476	8.29
Medium	7473	7938	6.22	11209	13097	16.84
Large	18994	20577	8.33	24943	27304	9.47

It can be seen from the table that in the pre-development situation income could not be increased appreciably through reallocation of resources in small farms whereas in the medium and large farms it could be increased by 6.22 per cent and 8.33 per cent respectively. In the post-development situation, income could be increased in all the farms by optimizing the resource allocation.

There are several possibilities to reason out the behaviour. It might be that area under irrigation, both in absolute and relative terms, could have limited the crop choices and cropping intensity. In the sample farms, the percentage of income increase was inversely related to the percentage of area irrigated in the pre-development situation. However, the same cannot be said of post-development situation.

Alternatively one might suggest the management skills and efficiency could be attributed to increases in income. The small farms showed the potential for increase in income marginally by only 1.53 per cent showing high efficiency level and degree of stability. However, when changes were introduced in resources, particularly in area irrigated by 100 per cent, resource management required better control and use of resources which might have been acquired by experience and with lags in adjustment. Possibly, the large farmers did not face such problems and therefore changes during pre and post-development were marginal. The case of the medium farmer was somewhat mixed which could be explained assuming adequate management efficiency, in terms of changes in resource and crop choices.

(b) Changes in cropping pattern

The existing cropping patterns under the pre and post-development situations are compared with the optimum plans in Table XXVI.

TABLE XXVI

COMPARISON OF CROPPING PATTERN IN EXISTING PLANS WITH OPTIMUM PLANS IN PRE-, AND POST-DEVELOPMENT SITUATIONS
(hectares)

Crop	Dry(D) or Irrig- ated (I)	Variety local (ordi.) or high yielding (HYV)	Sea- son	Land type (W) or garden(G) or Dry(D)	Small Farms		Medium Farms		Large Farms							
					Pre- development Exist- ing plan	Post- development Opti- mum plan	Pre- development Exist- ing plan	Post- development Opti- mum plan	Pre- development Exist- ing plan	Post- development Opti- mum plan						
Rice	D+I	Ord.	1	W	0.27	0.51	0.08	0.51	0.54	1.34	0.26	1.48	1.79	3.83	0.96	3.83
Rice	I	Ord.	1	W	0.21	-	0.24	-	0.29	-	0.66	-	0.71	-	1.65	-
Rice	I	HYV	1	W	-	-	-	-	-	1.14	-	-	-	-	-	-
Groundnut	I	Ord.	1	W	-	-	0.10	-	0.03	-	0.15	-	0.06	-	0.30	-
Rice	I	Ord.	2	W	0.37	0.03	0.37	0.44	0.97	0.55	0.67	1.04	2.55	3.83	2.22	-
Rice	I	HYV	2	W	0.13	0.47	0.13	-	0.51	0.94	0.51	0.44	1.22	-	1.22	3.83
Rice	I	Ord.	3	W	-	-	0.09	-	0.04	-	0.30	-	0.21	-	0.52	1.10
Rice	I	HYV	3	W	-	-	-	-	-	-	-	0.96	-	-	-	-
Groundnut	I	Ord.	3	W	-	-	0.11	-	0.27	-	0.38	-	0.16	-	0.59	-
Groundnut	I	Ord.	1	G	-	-	0.17	0.74	-	-	0.33	-	0.04	-	0.67	-
Rice	I	Ord.	1	G	-	-	0.19	-	-	-	-	-	-	-	0.26	1.61
Rice	I	HYV	1	G	-	-	-	-	-	-	0.29	0.79	0.26	-	0.21	-
Rice	D	Ord.	1	G	-	-	-	-	-	-	-	-	-	0.37	-	-
Rice	I	Ord.	2	G	-	-	0.64	0.74	-	-	0.41	-	-	-	1.20	-
Rice	I	HYV	2	G	-	-	-	-	-	-	0.36	0.52	0.31	0.28	0.40	0.56
Rice	I	Ord.	3	G	-	-	0.11	-	-	-	0.09	-	0.03	-	0.27	-
Rice	I	HYV	3	G	-	-	-	-	-	-	-	0.25	-	-	-	-
Groundnut	I	Ord.	3	G	-	-	0.16	0.28	-	-	0.42	-	0.18	-	0.76	-
Rice	D	Ord.	1	D	0.40	-	-	-	0.41	-	0.11	-	1.37	2.86	0.69	1.62
Groundnut	D	Ord.	1	D	0.34	-	-	-	0.89	-	0.20	-	1.28	-	0.58	-
Rice	D	Ord.	2	D	0.13	0.74	-	-	0.24	1.37	-	-	0.20	0.86	0.46	1.62

It was noted that the farmers grow a number of crops, in small extent of land, in different seasons. As seen in the optimum plans, the farmers, however, can limit the number of crops grown in their farms, with the resource limitations specified. The number of crops grown by the farmers in a year and the number of crops specified by the optimum plans are presented in Table No. XXVII.

TABLE XXVII
NUMBER OF CROPS GROWN IN THE EXISTING PLANS AND OPTIMUM PLANS
IN PRE AND POST-DEVELOPMENT SITUATIONS

Farm size	Pre-development situation		Post-development situation	
	Existing plan	Optimum plan	Existing plan	Optimum plan
Small	7	4	12	5
Medium	10	5	15	7
Large	15	6	17	7

The farmers were growing more number of crops than specified by the optimum plans. Further the number of crops grown in the post-development situation increased from the pre-development situation. The possible reason may be due to the following. A study of the MVP of the programmes revealed that capital was the most restricting factor. Some of the other

inputs viz., land, labour and irrigation water available in the farms were also left unused because of the capital restrictions. By growing a number of crops the farmers may harvest and sell the produce at a greater frequency, which may relieve the farmer from financial strain. If the optimum plans take into consideration, the family and farm needs at different periods of year, they may collaborate with the existing plan.

The above aspect was examined in more detail by studying the flow of incomes from the crops in optimum plans and farmers' existing plans. The statement of income flows for pre and post-development situations is presented in Table XXVIII. A study of the statement revealed that the flow of income was limited to a few months when optimum plans were adopted. In contrast the flow of income was more spread out in the farmers' practice. Further the gap between the income months were less in the existing plans as explained below.

	Number of months income was flowing	Maximum number of months (gap) between the two cash flows
--	-------------------------------------	---

Small Farms

Pre-development situation

Existing plan	6	3
Optimum plan	4	3

Post-development situation

Existing plan	11	1
Optimum plan	5	3

Medium Farms

Pre-development situation

Existing plan	8	1
Optimum plan	5	3

Post-development situation

Existing plan	12	--
Optimum plan	7	3

Large Farms

Pre-development situation

Existing plan	12	--
Optimum plan	4	3

Post-development situation

Existing plan	12	--
Optimum plan	4	4

The spread of income and shorter gap between receipt of the two incomes might have a bearing on the farmers' behaviour. The opportunity cost of income foregone by adopting the existing plans might be greater than the returns they can realise by adopting the optimum plans. Further it was noted that October, December, April and May were the months when maximum family expenses were incurred because of festivals. When optimum plans were adopted income flows were not realised during those months. Thus the preference of the farmers to the existing plan could be reasoned out.

TABLE XXVIII

COMPARISON OF MONTHWISE FLOW OF INCOME FROM CROPS IN PRE AND POST-DEVELOPMENT SITUATIONS

Particulars	(Rupees)											
	Month January	February	March	April	May	June	July	August	September	October	November	December
<u>Small Farms - Pre-development</u>												
Existing plan	418	777	-	-	-	96	-	-	786	-	445	415
Optimum plan	1532	67	-	-	-	549	-	-	844	-	-	-
<u>Small Farms - Post-development</u>												
Existing plan	1683	777	336	231	204	165	357	210	133	-	376	504
Optimum plan	1556	926	594	-	-	-	1556	-	844	-	-	-
<u>Medium Farms - Pre-development</u>												
Existing plan	1701	2154	-	537	-	247	-	59	1746	-	456	573
Optimum plan	3119	1214	-	-	-	1014	-	-	2152	-	439	-
<u>Medium Farms - Post-development</u>												
Existing plan	2512	1490	830	751	167	519	652	297	616	860	1189	1305
Optimum plan	1458	2322	-	682	2370	-	-	-	2378	2339	1548	-
<u>Large Farms - Pre-development</u>												
Existing plan	3769	5355	334	316	52	511	79	115	4095	642	2366	1360
Optimum plan	-	8049	-	-	-	2120	-	-	6060	-	4348	-
<u>Large Farms - Post-development</u>												
Existing plan	5993	4662	1408	1166	467	1241	1325	575	2091	519	2331	3160
Optimum plan	11840	-	-	-	-	3098	-	-	6060	-	6306	-

Eventhough the number of crops by season and variety was large they were in real terms the variation of three crops viz., rice, groundnut and ragi. In Table XXIX the area under the three crops grown in the farms are grouped and compared.

It can be noted from the table that growing groundnut was not contemplated in all the optimum plans except in small farms in post-development situation. But farmers were growing this crop invariably in all the situations. The reason for their behaviour might be as follows:- Farmers may prefer to grow their own crop of groundnut for the edible oil requirements in their homes. Government restrict the movement and sale of rice, as a policy. The hardship caused to the farmers for the marketing of rice may influence them to shift to groundnut cultivation. Further groundnut was also an equally paying crop like rice and at times it may be more profitable than rice. The farmers, therefore, did not rule out growing of groundnut. Probably a programme which considered, price risks and Government policies might permit growing of groundnut. Further, as noted earlier the farmers were growing more number of crops to increase the frequency of returns. Groundnut crop, since suited for cultivation in certain specific months, might have some preference among the farmers.

In Table XXX the area under crops are grouped according to the land type for comparison.

TABLE XXIX

NUMBER OF CROPS GROWN IN THE EXISTING PLANS AND OPTIMUM PLANS IN PRE-, AND POST-DEVELOPMENT SITUATIONS

Farm Size	Crop	Pre-Development Situations				Post-Development Situation				Percentage increase or decrease
		Existing plan		Optimum plan		Existing plan		Optimum plan		
		Area	Percentage	Area	Percentage	Area	Percentage	Area	Percentage	
Small	Rice	1.38	74.59	1.01	57.71	1.85	77.41	1.69	62.36	- 8.65
	Groundnut	0.34	18.38	-	-	0.54	22.59	1.02	37.64	+ 88.89
	Ragi	0.13	7.03	0.74	42.29	-	-	-	-	-
Medium	Rice	2.76	65.87	2.96	68.36	3.66	71.21	5.48	100.00	49.73
	Groundnut	1.19	28.40	-	-	1.48	28.79	-	-	-100.00
	Ragi	0.24	5.73	1.37	31.64	-	-	-	-	-
Large	Rice	8.45	81.49	11.17	79.62	9.60	74.07	12.55	88.57	+ 30.73
	Groundnut	1.72	16.59	-	-	2.90	22.38	-	-	-
	Ragi	0.20	1.92	2.86	20.38	0.46	3.55	1.62	11.43	+243.48

TABLE XXX

AREA UNDER CROPS CLASSIFIED ACCORDING TO LAND TYPE

Farm size	Land type	Pre-Development Situation				Post-Development Situation				Percentage increase or decrease
		Existing plan		Optimum plan		Existing plan		Optimum plan		
		Area	Percentage	Area	Percentage	Area	Percentage	Area	Percentage	
Small	Wet	0.98	52.97	1.01	57.71	1.12	46.86	0.95	34.93	- 15.18
	Dry	0.87	47.03	0.74	42.29	1.27	53.14	1.77	65.07	+ 39.37
Medium	Wet	2.65	63.25	2.96	68.36	2.93	57.00	3.92	71.53	33.79
	Dry	1.54	36.75	1.37	31.64	1.90	36.97	1.56	28.47	17.89
Large	Wet	6.70	64.61	7.67	54.63	5.98	52.09	8.76	61.82	+ 46.49
	Dry	2.85	27.48	5.72	40.74	3.77	32.84	3.24	22.87	- 42.40

In the pre-development situation, the small and medium farmers concentrated on the dry-land cultivation. This may be due to the following reasons: Dry lands are early lands i.e., they can be ploughed as soon as the first showers are received. The farmers started the ploughing operations much earlier in dry-land. However, later ploughing operations and sowings synchronised with wet land operations. Ploughing in dry lands were started so that bullock labour could be employed without keeping it idle; moreover dry lands could be prepared by the farmers only in stages, as and when the rains were received. Once the lands were ploughed, the farmers did not prefer to keep it fallow and therefore they raised the crops in these lands even postponing the wet land operations or even foregoing wet land crops in the first season. This was expected in the study, since the gross cropped area in wet lands was less in the first season. The large farmers had a balanced approach.

In the post-development situation small farmers concentrated more in the wet land probably because they lacked the experience of growing garden land crops. The medium and the large farmers concentrated on the garden land cultivation. Since the cost of cultivation was more in garden lands due to lift irrigation, the net value produce of garden land crops were relatively less. Concentrating on wet land crops, as indicated by the optimum plans, was therefore, more profitable.

Even then the farmers took up garden land cultivation just because water in the well was available althrough the year as against the availability of tank water, the duration of which was influenced by monsoon.

The area cultivated are grouped seasonwise and presented in Table XXXI for comparison.

The optimal solutions for pre and post-development cropping presuppose that the assumed groundnut-rice price ratio would continue to prevail and rainfall would be as expected. These assumptions are some what restrictive and the solutions, by specification, are deterministic. Furthermore changes in resource levels might, as will be discussed later with the results of multiperiod programming, influence the crop choices. The conclusions should therefore be considered in that perspective.

In Table XXXII the classwise and situationwise adoption of high yielding rice varieties in the sample farms are presented.

In the optimum solutions, as against the existing plan, for pre-development situation, the area under high yielding varieties in small and medium farms increased by 261.54 per cent and 111.76 per cent, respectively. For the large farm a reduction in area under high yielding varieties, by substitution with local varieties, could be noted in the optimum solution. For the post-development situation, the optimum

TABLE XXXI

AREA UNDER CROPS CLASSIFIED ACCORDING TO SEASONS

Farm size	Season	Pre-Development Situation			Post-Development Situation			Percentage increase or decrease			
		Existing plan Area	Existing plan Percentage	Optimum plan Area Percentage	Existing plan Area	Existing plan Percentage	Optimum plan Area Percentage				
Small	1	1.22	65.95	0.51	28.98	-58.20	0.78	24.61	1.25	46.13	+60.26
	2	0.63	34.05	1.25	71.02	+98.41	1.92	60.57	1.18	43.54	-38.54
	3	-	-	-	-	-	0.47	14.82	0.28	10.33	-40.43
Medium	1	2.16	51.55	1.48	34.18	-31.48	2.00	38.91	2.27	41.42	+13.50
	2	1.72	41.05	2.85	65.82	+92.57	1.95	37.94	2.00	36.50	+ 2.56
	3	0.31	7.40	-	-	-100.00	1.19	23.15	1.21	22.08	+ 1.68
Large	1	5.51	53.13	7.06	50.32	+28.13	3.84	33.45	7.06	49.82	+83.85
	2	4.28	41.27	6.97	49.68	+62.85	5.50	47.91	6.01	42.41	+ 9.27
	3	0.58	5.60	-	-	-100.00	2.14	18.64	1.10	7.77	-48.60

TABLE XXXII
ADOPTION OF HIGH YIELDING VARIETY IN OPTIMUM AND EXISTING PLAN

Farm size	Pre-Development Situation			Post-Development Situation			Percentage increase or decrease			
	Existing plan Area	Optimum plan Area	Percentage increase or decrease	Existing plan Area	Optimum plan Area	Percentage increase or decrease				
Small	0.13	5.35	0.47	25.68	+261.54	0.13	4.17	--	--	-100.00
Medium	0.51	20.99	1.08	59.02	+113.73	1.16	37.18	2.96	40.27	+155.17
Large	1.79	73.66	0.28	15.30	- 84.83	1.83	58.65	4.39	59.73	+139.89

solution, as against the existing solution had suggested for increasing the area under high yielding varieties in medium and large farms by 155.17 per cent and 139.89 per cent, respectively whereas in the small farms the high yielding varieties were not recommended. The results seem to join on issue with controversies about the efficiency of high yielding varieties, vis-a-vis the adoption of complementary practices which go with them in package. An examination of the MPV of the resources and cost component of the computer results would indicate that capital was a limiting factor. This would constrain the adoption of package of practices involving larger outlay in purchased inputs. Given differential availability of capital it would seem plausible to substitute high yielding varieties by traditional varieties over a range. If more short-term finance have been made available to meet the increased cultivation expenses the area of high yielding varieties could be increased with advantage.

(c) Cropping Intensity

Intensity of land utilisation is manifest on cropping intensity and is measured as a ratio of gross cropped area to net cultivable area and expressed usually in percentage terms. In Table XXXIII the cropping intensity of the optimum plans in the post-development situations are compared with existing plans of the two situations.

TABLE XXXIII

COMPARISON OF CROPPING INTENSITY OF OPTIMUM PLANS WITH
EXISTING PLANS IN PRE- AND POST-DEVELOPMENT SITUATIONS

Farm size	Cropping intensity in pre-development situation			Cropping intensity in post-development situation		
	Existing plan	Optimum plan	Difference over existing plan	Existing plan	Optimum plan	Difference over existing plan
Small	148.36	140.34	-8.02	191.66	217.32	25.66
Medium	147.07	151.98	4.91	180.41	192.45	12.04
Large	146.84	198.74	51.90	183.52	200.68	17.16

The optimum crop-mix revealed an increase in cropping intensity in the farms in all the cases except in small farms under pre-development situation. Since, in the small farms, the cropping pattern was oriented towards dry land crops there was a reduction in the cropping intensity. Optimum income levels could be achieved by intensive cultivation of wet land area instead of extensively cultivating dry land. In the post-development situation, there was no dry land in the optimum plan of the small farms and there was a great scope for intensive cultivation in wet and garden lands.

In the large farms there was scope for increasing cropping intensity by 35.34 per cent in pre-development situation and 9.35 per cent in the post-development situation. Eventhough the percentage of increase in cropping intensity was very high in the pre-development situation, the increase

in income was not so high probably because that the farmers had already chosen high income crops.

In the pre-development situation when sufficient water was not available high yielding varieties were not preferred due to high risk, as was evident from the optimum crop plans. However, farmers planted high yielding rice varieties even by reducing the total cultivated area in response to intensive campaign by the State Department of Agriculture and favourable ruling price for rice.

Moreover, rice was a staple food and decision to grow rice in certain extent for home consumption, particularly in small farms, imply certain trade off between income and preference to rice production for home consumption.

In the medium farms the increase in cropping intensity in the optimum cropping patterns were only nominal.

(d) Human Labour utilization

The pattern of human labour utilization in pre-development and post-development situations is given in Table XXXIV.

The human labour utilization increased in the post-development situation in all the farms.

TABLE XXXIV

HUMAN LABOUR UTILIZATION IN PRE AND POST-DEVELOPMENT SITUATIONS

(mandays)

Farm size	Pre-development situation			Post-development situation		
	Existing plan	Optimum plan	Difference (per cent) over existing plan	Existing plan	Optimum plan	Difference (per cent) over existing plan
Small	389	320	-17.74	626	639	2.08
Medium	932	859	-7.83	1298	1398	7.70
Large	2381	2664	11.89	3029	3165	4.49

The developments carried out in the farms had generated increase in the employment opportunities in farms and the rural areas. The increases in the human labour utilization between the two existing plans in the small, medium and large farms were 60.93 per cent, 39.27 per cent and 27.28 per cent, respectively. The increases between the two optimum plans were 99.63 per cent, 62.75 per cent and 18.81 per cent, respectively for the small, medium and large farms.

In the pre-development situation the comparison between the existing plan and optimum plan revealed that in small and medium farms, labour use could be reduced by adopting the optimum cropping pattern. In post-development situation it was possible to create additional employment opportunities by adopting optimum plans.

(e) Bullock Labour utilization

The pattern of bullock labour utilisation in pre-development and post-development situations are given in Table XXXV.

TABLE XXXV
BULLOCK LABOUR UTILIZATION IN PRE AND POST-DEVELOPMENT SITUATIONS

Farm size	(bullock labour days)					
	Pre-development situation			Post-development situation		
	Existing plan	Optimum plan	Difference over existing plan (per cent)	Existing plan	Optimum plan	Difference over existing plan (per cent)
Small	130	108	-16.92	172	195	13.37
Medium	295	277	- 6.10	370	395	6.76
Large	741	939	26.72	922	980	6.29

As in the case of human labour, the bullock labour use also increased in the post-development situation in all the farms. However, the increase in bullock labour use in the post-development situation was not as high as human labour utilization. The increase in the bullock labour use between the two existing plans in the small, medium and large farms were 32.31 per cent, 25.42 per cent and 24.43 per cent, respectively. The increase between the two optimum plans were 80.56 per cent, 42.60 per cent and 4.37 per cent, respectively.

In the pre-development situation the optimum crop-mix required less bullock labour in small and medium farms.

(f) Marginal value productivity (MV)

The MVPs derived under different programmes are presented in Table XXXVI and discussed below.

In the small farms first and second season wet lands, second season dry land and capital were the most critical resources, the use of which would increase the farm income in the pre-development situations. In the post-development situation first season wet land, first and second season garden land, second season labour and capital were the most critical resources the addition of which will earn higher profits in the farms. It is relevant to point out that, due to capital restrictions, labour and irrigation water available in the farms could not be used in full, for cultivating third season crops both in wet and garden lands.

In the medium farms, in pre-development conditions, first season wet land, second season dry land, second season labour and capital are the crucial resources that will enhance the farm's income. Since labour was scarce, in all the three seasons, farmers may use labour saving implements suited to their conditions. In addition to the capital restrictions, the water and labour restrictions prohibited the medium farmers from cultivating the entire holding, in the third season.

TABLE XXXVI

MARGINAL VALUE PRODUCTIVITIES OF THE RESOURCES CONSIDERED IN THE PROGRAMMES

Resources considered	Pre-development situation			Post-development situation		
	Small farms	Medium farms	Large farms	Small farms	Medium farms	Large farms
<u>Wet land</u>						
Season 1	150.00	142.31	190.00	179.17	68.53	168.57
Season 2	25.00	151.44	187.14	0	82.12	182.14
Season 3	NC	0	0	0	0	0
<u>Garden land</u>						
Season 1	NC	NC	50.00	70.83	0	30.95
Season 2	NC	NC	0	47.54	0	0
Season 3	NC	NC	0	0	0	0
<u>Dry land</u>						
Season 1	0	0	50.00	NC	0	30.95
Season 2	75.00	74.52	86.55	NC	0	90.48
<u>Human labour</u>						
July	0	0	0	0	50.54	0
November	0	1.72	2.57	1.91	61.23	0
April	NC	0	0	0	19.22	0
<u>Irrigation water</u>						
June	NC	0	0	0	0	0
April	NC	0	0	0	35.48	0
<u>Capital</u>	1.50	1.44	1.25	1.42	0.30	1.31

NC = Not considered in the programme

In the large farms, both in the pre-development and post-development situation the first season dry land resource was scarce, as revealed by the MVP. The MVP of third season wet land and garden land are zero just because they cannot be utilized in full. They cannot be used, eventhough labour and water were available, due to capital restrictions.

In general, it could be stated that capital was the most restricting resource which limit the crop-mix, in the farms. Because of capital requirements, cultivation of crops in the third season were limited. In the succeeding section where multiperiod dynamic model, permitting the addition of capital resources, from out of the savings were permitted, the possibilities of increasing the farm income are examined.

F. Estimating Farm Growth

(i) Specification of model

The present study also attempted to estimate the growth of the farm by using multiperiod linear programming technique. The study was confined to the analysis of minor-irrigation projects only. An average farm situation, constructed out of 100 sample farms, formed the basis of the study. Growth was projected from a threshold situation to a period of ten years. The farm situation at the threshold of development is given in Table XXXVII.

TABLE XXXVII
 FARM SITUATION AT THE THRESHOLD PERIOD

Particulars	Unit	Quantity
Resources		
Land		
Wet land	ha	1.58
Garden land	ha	0.08
Dry land	ha	1.42
Irrigation availability	ac. inches	19.30
Labour	man days	977
Working capital		
Owned	Rs	2000
Borrowed	Rs	3100
Cropping intensity	Per cent	147.57

At the threshold situation, the size of the farm firm was 3.08 hectares of which wet lands accounted for 51.30 per cent whereas garden and dry lands shared the rest at 2.60 per cent and 46.10 per cent, respectively. The cropping intensity was 147.51 per cent and the owned capital was Rs.3100.

A development strategy was specified to provide for one shot injection of external capital financed by the land development banks. The amount of capital was taken as Rs.8,000 and this was to be repaid in nine years in equated annual instalments at 11 per cent interest. It was assumed that the savings generated by the investment would be available and automatically transferred to the next period for additional investment. This transfer of funds would induce further developments in the farms and thus growth of the farm sets in.

Growth may be defined as an increase in the size of the farm firm which can be measured by the changes in the land, reckoned in efficiency units, and increase in the liquid capital reserves. For the present study the efficiency units were defined to reflect the gradations in type, fertility and gradient of lands which were, in turn, determined by the availability of irrigation water lifted and/or conveyed, and levelling and bunding of lands by mechanical contrivances. Specifically, for the present analysis, the elements of growth considered were (a) acquisition of additional lands by purchase, (b) changes in the distribution of land between

wet, garden and dry land types, (c) acquisition by purchase of machinery, equipment and tools, (d) building additional irrigation structures such as wells, pipelines and pumpset and (e) increase in the availability of working capital.

Generally in minor-irrigation projects there was one year time lag between the investment and generation of benefits. The farmer would decide on the changes in the resource levels only after the one year and decisions would be implemented in the second year. It was therefore necessary to consider every two years, including one year lag for production and the other in decision, as one production period. Thus, the model covered 10 years divided into five periods each consisting of two years. The objective of the study was to estimate the growth pattern as the farmer repays the loan amount. Since the loan amortization period was nine years, this along with one year grace period was taken for the programme. The multiperiod programme thus considered the development of the farm in ten years consisting of five two year periods.

(ii) Formation of the Technological Matrix

As in any other linear programming model, the multiperiod programming model also consists of (i) a structure of constraints, (ii) an activity set and (iii) objective function. In this dynamic model the structure of constraints included the constraints of resource transfers from one period to the other. The structure of constraints and the activity set were specified for each production period separately.

(a) Constraints Structure

The constraints structure consisted of (a) agricultural land, (b) agricultural labour, (c) working capital, (d) machinery and livestock, (e) irrigation water and (f) investible funds for transfer or acquisition of resources. The methodology adopted in the computation of the constraints structure is explained hereunder.

1. Agricultural Land

As detailed in the preceding section on Optimum Plans, agricultural land consisted of three types viz. wet, garden and dry lands. The wet and garden lands were further divided into three seasonal lands. The dry lands were subdivided into two seasonal lands. The initial land availability was constant for all the five periods. However, the multiperiod model would consider the transfer of funds from savings for addition of lands by purchase from period two to five. Thus for any one period the area of any type of land (L_i) would be

$$L_{ip} = L_{i1} + \sum_{p=2}^p \Delta L_{ip},$$

$$p = 1, 2, 3, 4, 5$$

$$i = 1, 2, 3.$$

where

$$L_{i1} = i^{\text{th}} \text{ land availability in the initial period}$$

$$\Delta L_{ip} = \text{addition of } i^{\text{th}} \text{ land resource in period } p \text{ by}$$

purchase from investible funds

2. Agricultural Labour

The labour availability for the programme was also

computed in the same manner as was done before for the linear programming analysis. However, as the programming was done for a 10 year period, it was considered necessary that the growth of agricultural population over years should also be taken into account. The Census data revealed that the growth of agricultural labour population was 2.5 per cent per annum.¹⁰ Accordingly, the labour availability was computed for every period and due weightage was given while specifying the constraint. Further as per the methodology explained earlier¹¹ the labour availability was computed as a ratio of total labour population to the total cultivable area. It was therefore necessary that whenever additional land was acquired by the farmers the labour availability for the farm should also be increased proportionately. Thus the labour constraint may be specified as follows.

$$B_t = B_{t-1} (1 + 0.025) + \Delta L_{ip} b_t;$$

$$p = 1, 2, 3, 4, 5.$$

$$t = 1, 2, \dots, 10.$$

$$i = 1, 2, 3$$

where:

B_t = Total labour availability in t^{th} year

$\Delta L_{ip} b_t$ = Labour unit added with the addition of land resource ΔL_{ip}

b_t = Labour co-efficient per unit land area in year t .

¹⁰Government of Tamil Nadu, Census Hand Books. (Madras: Superintendent Government Press, 1961 and 1971)

¹¹See page 147

3. Working Capital

Working capital availability in the farm in the initial year was worked out in the same manner as it was done under the section, Optimum Crop Plan Analysis.¹² As the objective function was maximization of the present value of the income flows it was necessary that all the monetary values considered in the programme were discounted at the market rate of interest viz. 11 per cent. Accordingly, the capital availability in the subsequent periods were discounted. Further, working capital was included as an activity with provision of transfer of investible funds to the working capital. Thus the working capital availability for any one year (C_t) would be

$$C_t = (1.11)^{-1} C_{t-1} + \Delta C_t$$

$$t = 1, \dots, 10$$

where:

ΔC_t = addition of capital in year t by purchase from investible funds.

4. Machinery and Livestock

As development takes place more and more area will be brought under irrigated agriculture, farmers have to acquire additional equipments, machinery, tools and livestock. In the present study, the requirement of machinery and livestock during the growth period was included as a constraint.

¹²See page 149

The initial availability of total assets consisted of the assets acquired through owned and borrowed funds, existed in the farms at the threshold period and the addition of this resource during the subsequent years provided for. As the assets were expressed in monetary terms this constraint was also discounted at 11 per cent in the subsequent years. Thus the value of assets in any one year (A_t) would be

$$A_t = (1.11)^{-t} A_0 + \sum_{i=1}^t \Delta A_i (1.11)^{-i}$$

$$t = 1, \dots, 10$$

where:

ΔA_t = addition of machinery and livestock asset in year t
by purchase from investible funds.

5. Irrigation water

Based on the seasonal availability, irrigation water was included as a constraint for two seasons, viz., June and April.

However, in the subsequent years the availability of water resource for irrigation might vary due to the following three activities specified: (a) purchase of garden land with proportionate water resource, (b) conversion of dry land to garden land with addition of irrigation facilities and (c) construction of irrigation structures like pipelines, channels and/or deepening of wells or hiring of water. The irrigation potential (W_p) of any one period was estimated

using the following relationship.

$$W_p = \bar{W} + \sum \beta \Delta L_{gp} + \Delta W_p$$

$$p = 1, 2, 3, 4, 5$$

where:

\bar{W} = water resource in initial year

$\beta \Delta L_{gp}$ = water added in p^{th} period when garden land is purchased

β = unit of water related to an unit of garden land

ΔW_p = units of water added by construction of irrigation structures in period p .

6. Investible funds

Investible funds were built out of savings in the farm.¹³ The investible funds were the farm income after meeting all the expenses like family expenses, loan repayments, maintenance and repair charges of implements, and recurring liabilities. In the programme matrix deductions of expenses were provided by specifying it as a negative resource in the constraint structure.

Further the following assumptions were made:

(i) family expenses would grow every year at the rate of

¹³ Normally one would include owned and borrowed capital in investible funds. Since borrowed capital was assumed to be injected one time and no more, the investible funds were defined rather narrowly for the present analysis.

10 per cent, (ii) the increase in family expenditure was assumed to occur from second period i.e. after the increased returns were realised, (iii) the fixed liabilities would be constant throughout the 10 year period and (iv) there would be some supplementary expenses following the development in the initial periods. With these assumptions, the expenses were calculated and specified as constraints. Further, constraint with the objective function of the programme the monetary values were discounted. Thus the investible funds (I_t) for any one year would be:

$$I_t = C_{jt} X_{jt} - (D_t + L_t + E_t)$$

$$t = 1, \dots, 10$$

$$j = 1, \dots, 22$$

where:

C_{jt} = the net value of the j^{th} activity in t^{th} year

X_j = the level of j^{th} activity in the programming solution in t^{th} year

D_t = the annual instalment of loan repayment with interest

L_t = fixed liabilities for year t and

E_t = family expenses for the year t

The resource constraint of expenditures, second term of RHs, for arriving at the investible funds for the five periods are presented in Table XXXVIII.

TABLE XXXVIII

VALUE OF RESOURCE CONSTRAINTS OF INVESTIBLE FUNDS DURING FIVE PROGRAMMING PERIODS

Item	(Rupees)									
	Years 1	2	3	4	5	6	7	8	9	10
Equated annual instalment for the loan of Rs.8000/- at 11 per cent <u>a/</u> interest	1245	1245	1245	1245	1245	1245	1245	1245	1245	1245
Annual fixed liabilities, list, taxes, temporary deadstock and repairs	900	900	900	900	900	900	900	900	900	900
Subsidiary improvements <u>b/</u>	600	500	150	100	100	-	-	-	-	-
Family expenses	6500	6500	7150	7865	8652	9517	10468	11515	12667	13933
Total for the year	8000	9145	9445	10110	10897	11662	12613	13660	14812	16078
Discounted amount	8000	8235	7670	7390	7186	6922	6748	6586	6425	6282
Value of constraint for the five periods	16235			15060		14108		13334		12707

a/ Nil since a grace period of one year was permitted

b/ As per enquiry findings this amount was restricted to five years

7. Maximum land limit

Land acquisition by purchase with investible funds was envisaged in the programme. Since the government do not permit an individual to own land more than 15 standard acres, the ceiling on land was imposed as a constraint. The coefficients for different types of lands were specified as per the conversion ratios explained earlier.

(b) Activity set

The activity set consisted of crop and investment activities. The crop activities considered in the programme were the same as those considered in optimum crop plan analysis.¹⁴

The investment activities included in the programme were (a) purchase of wet lands, (b) purchase of garden lands, (c) purchase of dry lands, (d) conversion of dry land to garden land, (e) transfer of funds to working capital, (f) purchase of machinery, equipments and tools and (g) construction of irrigation structure reflected in the increase of irrigation water potential in the farm. The investment activities used the investible funds of year t and would provide additional resources from the subsequent years.

Each of this activity had a cost and as the activity entered in this programme, proportionate cost would be debited to the investible funds.

¹⁴See page 154.

(c) Technological Matrix

The input-output co-efficients of each activity were estimated on the basis of information collected from the sample farms. The input co-efficients used in the technological matrix are given in Table XXXIX. The technological matrix is truncated somewhat, for want of space, and includes a few of the activities only. Details with respect to each activity are given in Appendix F wherein the deck for the programme is listed. While constructing the matrix all the money values were discounted at 11 per cent with reference to the year.

The construction of input co-efficient of the resource-machinery and livestock with respect to activities needs specific mention. The machinery equipment and tools used in the farms were listed. The capacity of each with reference to all of the activities was estimated as explained below. For example, an electric motor pumpset valued at Rs.3,500 has the capacity to irrigate 10 units of rice crop or 14 units of groundnut crop. Then, the machinery and livestock requirement per unit of one acre rice activity is Rs.350 and that of groundnut activity is Rs.200. Likewise the estimates of machinery and livestock requirements for each activity were worked out. The requirements for each activity were aggregated to derive the input co-efficient specified in the technological matrix. The details are given in the Table XL.

This method of deriving the co-efficients of machinery requirement, though needs further refinement, served the

TABLE XI

WORK SHEET OF MACHINERY-LIVESTOCK INPUT COEFFICIENT - AVAILABILITY AND REQUIREMENT

Crop activity	Equipment	Elec- tric motor pump- set	Wet- land pud- dler	Parambu (wet- land level- ler)	Gorru (Seed- ing equip- ment)	Palukku (Dry- land inter- culti- vator)	Pavat- tam (Dryland inter- culti- vator)	Plough matti (Spade)	Mam- Hand hoe	Sickle bar etc.	Crow bar etc.	Tempo- rary dead- stock	Live- stock input coeffi- cient)	Total (used as input coeffi- cient)
Total Availability of each item in value terms														
Requirements for crop														
1. Rice local	D + I	150	50	-	15	10	10	80	60	25	55	120	1000	400
2. Rice	Dry	-	50	-	15	10	10	15	5	20	5	20	80	250
3. Rice local	Irrigated	350	50	5	-	-	-	15	5	-	5	20	125	600
4. Rice HVV	Irrigated	350	60	5	-	-	-	20	5	25	5	25	125	625
5. Groundnut	Irrigated	250	50	-	-	-	-	15	10	25	5	20	125	500
6. Groundnut	Dry	-	50	-	15	10	10	15	5	20	5	20	50	200
7. Ragi	Dry	-	20	-	15	5	5	6	4	-	5	10	20	100

purpose for estimating the additional asset requirements as the farm growth took place.

Specification of returns as input coefficients of the investible funds also needs explanation. The returns from the activities entering the programme should be credited to the investible fund constraint so that savings could accrue. The net value product was worked out as income from crops for any one year. Since a period was defined to include two years twice the net value product would accrue to the investible funds in the period. A negative sign was assigned to this coefficient so that the returns would be credited to investible funds. The input coefficients with respect to other resource constraints were specified as in any linear programming problem.

(d) Net Value Product For the Activity Set

The net value products of the activities were computed as detailed earlier under optimum crop plant analysis.¹⁵ It was assumed, somewhat restrictively, that the prices would remain constant throughout. However, the net value product specified in the initial period was discounted at 11 per cent interest rate. Thus the net value product (NVP_p) of an activity in any one P will be

$$NVP_p = NVP_{p-1} (1.11)^{-2}$$

P = 1, 2, 3, 4, 5 periods

¹⁵See page 158

(e) The objective function

The objective function for this part of analysis was maximizing the present value of the farm income over five two-year periods. The objective function of this multi-period programming model is given below.

$$PVI = \sum_{t=1}^T \left[\frac{\sum_{j=1}^n C_{jt} \cdot X_{jt}}{(1+r)^t} \right]$$

(Present value of farm income) = Sums of the discounted annual net farm income

Subject to

$$\sum_{i,j,t} a_{ijt} X_{it} \leq B_{it}; \quad \begin{array}{l} i = 1, 2, \dots, m \\ j = 1, 2, \dots, n \\ t = 1, 2, \dots, T \end{array}$$

Resource Utilization \leq Resource availability

where $B_{it} = B_{i,t-1} + \bar{B}_{it}$

resource availability = Initial availability + additions during the year
for any one year

Subject to

$$\sum \bar{B}_{it} = \alpha_1 \left[\sum C_{j,t-1} X_{j,t-1} - Y_{t-1} \right]$$

Resource added = price x investible funds factor of resource

where α_1 = Value price factor

Subject to

$$\begin{array}{rcccc}
 Y_t & = & E_t & + & D_t & + & L_t \\
 \text{Total} & & \text{Family} & & \text{Debt} & & \text{Fixed} \\
 \text{Expenses} & = & \text{expenses} & & \text{repayment} & & \text{liabilities}
 \end{array}$$

where

$$E_t = E_{t-1} + \Delta E_t$$

$$D_t = P_t + I_t$$

$$L_t = L_{t-1} + \Delta L_t$$

Subscript to non-negativity conditions

$$X_{it}, B_{it}, E_t, D_t, L_t \geq 0$$

Subscripts

j = the activity, $j = 1, \dots, n$

i = the input constraint $i = 1, \dots, m$

t = the period dimension $t = 1, \dots, t$

Coefficient

α_i = Value price coefficient of i^{th} resource

C_{jt} = the annual returns above variable cost of one unit of activity j in period t (net value product of activity)

Variables

X_{jt} = the level of production activity j in period t

B_{it} = the amount (physical or value terms) of resource i available in period t

Y_t = Expenses (debits) in the farm in year t

E_t = Family expenses in year t

- D_t = Annual instalment of debt repayment
 L_t = Fixed liabilities in year t
 P_t = Principal part of debt repaid in year t
 I_t = Interest part of debt paid in year t

The programme solutions were obtained in MPS/360 computer. The results of the multiperiod programme are given in Appendix F.

Discussion of multiperiod programming results

(i) Changes in efficiency units

The periodwise expansion of the farm firm, by self-generating investment, during the course of ten years was compared with the threshold situation. The results are presented in Table XLI.

A study of the table would reveal that the land area could be increased from 3.08 hectares in the threshold situation to 9.32 ha i.e. 202.60 per cent. The distribution of the additional area among the three land types presented an interesting feature. There was no expansion of the wet land area but, however, there was a decrease in the area of dry land in the first period as compared to threshold period, because of conversion of dry lands to garden lands by increasing irrigation facilities. Nevertheless, in the subsequent periods there was increase in the area under dry land by fresh purchase with the investible funds generated within the farm. The total purchase of dry land amounted to 6.24 ha. and the percentage of

TABLE XII

PERIODWISE EXPANSION OF THE FARM FIRM

Particulars	Unit	Thresh- old situa- tion	Programming periods					Per cent increase from thresh- old period
			1	2	3	4	5	
1. Wet land	ha	1.58	1.58	1.58	1.58	1.58	1.58	-
2. Garden land	ha	0.08	1.00	1.00	1.00	1.83	3.46	42.25
3. Dry land	ha	1.42	0.50	1.09	2.78	3.74	4.29	202.11
4. Total holding(1 to 3)	ha	3.08	3.08	3.67	5.36	7.12	9.32	202.60
5. Gross cropped area	ha	4.54	5.04	8.21	12.41	16.94	23.07	408.15
6. Cropping intensity	Per cent	147.57	163.64	223.71	231.53	237.92	247.53	99.96
7. Net farm income per year (at 1974-75 prices)	Rs	8057	12,982	17,887	24,852	33,937	47,766	492.85
8. Dry land purchases	ha	-	0.59	1.69	1.76	2.20		
9. Conversion of dry land to garden land	ha	-	-	-	0.83	1.63		
10. Additions to working capital	Rs	-	3,298	3,841	5,367	8,372		
11. Addition to Farm Machinery	Rs	-	2,442	3,118	4,095	6,611		
12. Improvement of water (acre inches)	-	-	-	11.85	26.75	44.39		

increase in the dry land over the threshold period worked out to 202.11. The garden land area had increased from 0.08 hectare in threshold situation to 3.46 hectare in the final period. Garden land, though the most profitable, was not purchased. The increase in the area under garden land was the result of conversion of dry land to garden land. One could note that purchasing dry lands and converting them as garden lands would be relatively less expensive than the straight purchase of garden land. The cropping intensity increased from 143 per cent in the threshold situation to 247.53 per cent in the final period.

In addition to the growth in the size of farm as development took place, investment on other physical assets such as machinery and livestock asset and water potential of the farm, and working capital of the firm. The value of added machinery and livestock asset amounted to Rs.16,266; the increase in working capital resource was Rs.22,378; and the improvements to irrigation structures added to the water potential by 92.99 acre inches, the money equivalent being Rs.55,794.

The production activities in the threshold situation and activities based on optimum crop plans during the five periods are presented in Table XLII.

It could be noted that the local variety of rice grown in garden and wet lands in the threshold period were completely

TABLE XLII

OPTIMUM CROP PLANS IN DIFFERENT PERIODS

(in hectares)

S. No.	Crop/variety	Irrigated (I) or Dry (D)	Season	Land Type	During threshold situation	During programming periods				
						1	2	3	4	5
1.	Rice (local)	D + I	1	Wet	0.72	0.27	1.30	0.35	-	-
2.	Rice (HYV)	I	1	Wet	-	1.31	0.28	1.23	1.58	1.58
3.	Rice (local)	I	1	Wet	0.35	-	-	-	-	-
4.	Rice (HYV)	I	2	Wet	0.50	1.58	1.58	1.58	1.58	1.58
5.	Rice (local)	I	2	Wet	1.06	-	-	-	-	-
6.	Rice (HYV)	I	3	Wet	-	0.50	1.21	1.58	1.58	1.58
7.	Groundnut (improved)	I	3	Wet	0.13	-	-	0.11	1.12	2.81
8.	Rice (local)	D	1	Garden	-	0.06	0.02	-	-	-
9.	Rice (HYV)	I	1	Garden	0.07	-	0.98	1.00	1.83	3.46
10.	Rice (HYV)	I	2	Garden	0.06	0.32	0.64	1.00	1.83	3.46
11.	Groundnut (improved)	I	3	Garden	0.05	-	-	0.11	1.12	2.81
12.	Rice (local)	D	1	Dry	0.68	0.50	-	2.78	3.74	4.29
13.	Groundnut (improved)	D	1	Dry	0.74	-	1.09	-	-	-
14.	Ragi (local)	D	2	Dry	0.18	0.50	1.09	2.78	3.74	4.29

replaced by HYV in the development period. This might have been possible only by new investment through injection of capital. This confirms the earlier findings, presented in the previous section on optimum crop plan; that the capital was a limiting resource which influenced the adoption of HYV. The HYVs would respond well to agronomic practices involved in soil and water management. By removing capital restraints through injection of additional capital for investment in developing water resources in the farm, a favourable situation for adoption of HYVs was created. As additional water potential was created, rice grown in semi-dry conditions was also substituted with irrigated rice of HYV. The third (summer) crop area in wet lands could also be increased with adjustment lag. It may be noted that though growing of groundnut in wet lands was possible during seasons 1 and 3, the optimum plans did not have groundnut included.

In the threshold period three crops were grown in garden lands whereas in the optimum plans the garden land area was not fully utilised. The first and second period crops were grown during the season 1 and 2 only. The cultivation of third crop was made possible only from the third period. The crop recommended for the third period was irrigated groundnut. Irrigation water and land might have been a limiting feature for the cultivation of rice crop in the third period.

The cropping intensity of dry land was increased from 112.2 per cent to 200 per cent throughout the programme period.

However, the choice of crops present a mixed trend. Ragi was cultivated in the entire area in dry land in season 2 throughout the programme period, whereas it was cultivated in 12.2 per cent of the area at the threshold. In season 1 either rice or groundnut was cultivated in the programme period whereas in the threshold period both rice and groundnut were cultivated.

(ii) Income and savings

Net farm income, debits comprising consumption, fixed liability, debt repayment, and net savings for five periods are compared with the threshold situation in Table XLIII.

It can be seen from the table that the net farm income, debits and savings increased by 492.85 per cent, 108.14 per cent and 4826.03 per cent, respectively over the threshold situation. The debits, comprising of the consumption, debt repayment and fixed liabilities had not increased in proportion to the net farm income. This might also be due to the assumption of 10 per cent increase in consumption expenditure per year.

The savings, as a proportion to the net farm income, had increased from 8.15 per cent in the threshold situation to 67.76 per cent, in the fifth period which suggested that the rate of savings would tend to directly related to size of the farm. The net income per hectare was Rs.5,232 in the threshold situation and had increased to Rs.10,250 in the fifth period and for the same periods the savings per hectare was Rs.426.62 and

TABLE XLIII
EXPANSION OF SAVINGS IN THE FARM FIRM

Sl. No.	Particulars	Thresh- old situa- tion	Programming periods					Per cent increase over period one	Per cent increase over threshold situation
			1	2	3	4	5		
1.	Net Farm income	16114	25964	35774	49704	67874	95532	267.94	492.85
2.	Debits	14800	17080	19520	22536	26222	30804	80.35	108.14
3.	Savings	1314	8884	16254	27168	41652	64728	628.59	4826.43
4.	Savings as a percentage to net farm income	8.15	34.22	45.44	54.66	61.37	67.76		

Rs.6,945, respectively. Thus one might conclude that new investment had generated two types of changes: increase in size of the farm and improvement in the productivity of land. The farmer enhanced the scope for intensity of cultivation and crop diversification and, in turn, income and saving. The latter increased farm output and thereby income and savings.

(iii) Farm firm growth

The growth, in the present study was measured in terms of changes in land reckoned with efficiency units. The increase in the size of land and other efficiency units are given in Table XLIV.

As already observed, the extent of land area had increased from 3.08 to 9.32 ha., by 202.60 per cent. The highest percentage of increase in area was noted under garden land which indicated that more area was brought under assured irrigation facilities. This is probably because of scope for growing variegated irrigated crops in garden land as compared to wet land area.

The irrigation availability was stepped up by 715.44 per cent over the threshold period. The labour use was increased by 390.98 per cent, from 610 mandays to 2995. In terms of percentage the labour use has increased from 62.44 per cent to 72.92 per cent. This points out that there is scope for better utilisation of available labour. It is necessary to point out another aspect of labour employment. The rate of absorption

TABLE XLIV

GROWTH OF EFFICIENCY UNITS OVER THE FIVE PERIODS AS COMPARED TO THE THRESHOLD SITUATION

Efficiency units	Thre- shold situa- tion	Growth in programming situation					Percentage increase from thre- shold to final period	Compound growth rate
		1	2	3	4	5		
Wet land (hectares)	1.58	1.58	1.58	1.58	1.58	1.58	-	-
Garden land (hectares)	0.08	1.00	1.00	1.00	1.83	3.46	4225.00	6.272
Dry land (hectares)	1.42	0.50	1.09	2.78	3.74	4.29	202.11	5.415
Total (hectares)	3.08	3.08	3.67	5.36	7.12	9.32	202.60	8.369
Irrigation availability (acre inches)	19.30	30.00	30.00	41.85	112.99	157.38	715.44	7.937
Labour availability (Mandays)	977	1026	1284	1969	2746	3774	286.28	-
Labour used (Mandays)	610	740	1138	1570	2144	2995	390.98	-
Labour used as percentage to availability	62.44	72.12	88.62	79.74	78.08	79.36	72.92	3.015
Cropping intensity percentage	147.57	163.64	223.71	231.53	237.92	247.53	99.96	7.228
Working capital owned Rs.	2000	2000	5298	9139	14506	22878	1044.00	-
Borrowed Rs.	3100	-	6000	6000	6000	6000	93.55	-
Equity (ratio)	0.3922	0.25	0.4689	0.6037	0.7074	0.7922	-	6.285
Net Farm income* Rs.	16114*	25964	35774	49704	67874	95532	492.85	8.942

* For one period of two years

of labour was 3.02 per cent (as revealed by growth rate) per period of two years while the rate of increase in supply of labour, assumed on the basis of the census figures, was 2.50 per cent per year. When the rate of absorption of labour was converted to the annual rate it was less than the rate of increase in the supply of labour revealing the possibility of unemployment. This could also be confirmed by the zero values of MVP of labour obtained from programming solution vide Appendix F.

The owned capital for working expenses has increased by 1044 per cent over the threshold period. This owned capital refers to the capital reserves accumulated by the farmer after investing for the acquisition of resources and assets as per the programme. The borrowed capital has increased by 93.55 per cent from threshold period. It is to be pointed out that borrowed capital is consistently maintained over the programme period because it was assumed to be so.

The compound growth rate of select indicators during the programming period was estimated and given below.¹⁶

¹⁶The growth rate was computed by employing the least square method of fitting exponential function $Y = AB^X$
 where: Y = observed value of the indicator
 B = (1 + r) where r is the compound growth rate
 X = period
 A = Initial value of the indicator

	<u>Compound growth rate</u> <u>for a period</u> (in per cent)
Resources	
Total land	8.34
Irrigation water	7.94
Labour use	3.02
Cropping intensity	7.23
Equity Capital	6.29
Net farm income	8.94

The results of the multiperiod linear programme analysis indicated that the future efforts need to be directed towards increasing income and savings of farms and the need to create necessary climate for the growth of capital formation. The investments must be selective such that stability in production system, output and income could be ensured. In this direction lies the potential for increasing the agricultural production of the area.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The objectives of the study were to estimate the rate of return in different types of projects financed by the land development bank, to identify the most profitable type of investment, to study and determine the optimum enterprise combination and to determine the desired course of farm growth, during the loan amortization period.

The study was based on the primary data collected by field survey in Kancheepuram taluk of Chingleput district, Tamil Nadu State. In the Kancheepuram taluk there are three primary land development banks at Kancheepuram, Uthiramerur and Walajabad, covering the three community development blocks in the taluk. The study covered all the beneficiaries of the three primary land development banks to whom loans were issued during the period from 1968-69 to 1972-73 and the operating area of the three banks formed the universe. A sample of 200 farms consisting of 100 minor-irrigation farms, 50 mechanized farms and 50 land reclamation farms were selected by random sampling for detailed study. For the purpose of analysis and interpretation of results the sample was post-stratified into small, medium and large size groups. The size of small farms ranged from 0.57 ha to

2.02 ha, whereas that of medium and large farms ranged from 2.03 ha to 4.04 ha and from 4.09 ha to 46.86 ha respectively.

The data for the study were collected from the farmers by survey method in the year 1974-75.

The general features of the farms as existed at the time of enquiry showed variation in the resource position between size groups and between purposewise categories. The average size of holdings in the sample farms varied from 1.09 ha to 13.98 ha for different size groups and various purposes considered for the study. The reclamation farms had the least size of holding and the largest size holding was in the mechanized farms. The percentage of irrigated lands to total area varied from 55.66 per cent in small farms in reclamation project to 100 per cent in small farms in minor-irrigation farms. Bullock pairs per farm were high in large farms of reclamation project. The family size was comparatively high in the mechanized farms. The value of assets, buildings, land and livestock, were lowest with Rs.345 in the small farms of Reclamation project, highest with Rs.39,504 in the mechanized farms.

With regard to purposewise distribution, in minor-irrigation farms the major purpose for which loans were

issued was for construction of wells with pumpsets. Only large farmers availed loan for mechanization projects. In reclamation farms and minor-irrigation farms the borrowers were mainly small farms. Of the four reclamation projects the maximum number of loans i.e., 16 out of 50, were used for the project converting dry land to garden land. The average quantum of loan utilized for various purposes showed an increasing trend with increase in size group. In all the projects, the final project cost exceeded the loan amount and the highest variation between the loan amount and final project cost was noticed in large farms of minor-irrigation purpose. The gap was filled by internal savings and borrowings from outside the land development banks and the proportion of such finance varied from 4.45 per cent in small farms of NPL project and 147.05 per cent in large farms of DPL project.

The impact of the projects on the farms were studied by examining the changes in the land types, cropping intensity, assets, working capital requirement and income.

In land type, there was a higher degree of change in minor-irrigation farms than in reclamation farms. There was no change in land type in mechanized farms. Between the land types, the rate of conversion of dry land into garden land was the maximum accounting upto 100 per cent in small farms of minor-irrigation purpose. There was no change in the area under wet land.

There was increase in cropping intensity in all sample farms after implementation of the project except in the case of mechanized farms adopting power tillers. The changes in cropping intensity was significant in small farms of minor-irrigation purposes wherein the increases ranged between 85 per cent and 131 per cent. With regard to income there was significant increase, in the post-development stage. The percentage of increase in net income was much higher in minor-irrigation farms with maximum of 102.50 per cent than in mechanized and reclamation farms.

There was no significant change in the value of buildings in the pre and post-development stages except in the minor-irrigation farms. The highest percentage of increase in building values 478.62 was noticed in farms implementing Pipe line project (L). With regard to livestock there was no change in the value between the pre and post-development stages in the small farms. In medium farms, except in the case of farms undertaking conversion of dry land to garden land projects, there was no change in the livestock values. In the case of large farms there was increase in the value of livestock by 25.16 per cent. This difference was pronounced especially in large farms investing in reclamation projects and new well projects. However, there was decrease in the value of livestock in mechanized farms.

There was increase in the total value of machinery, equipments and tools in the post-development stage in all the size groups and purposes of sample holdings. The highest percentage of increase i.e., 938.84 per cent, in the total value of assets was noticed in farms investing in NPL projects. Among the different size groups in minor-irrigation farms, the change was significantly higher i.e., 345.67 per cent in small farms, 114.45 per cent in medium farms and 71.82 per cent in large farms. In mechanized farms the increase was 354.66 per cent. In reclamation farms the highest increase was 288.75 in RCW project in small farms and the lowest was nil in RW project in small farms and RCW project in medium farms.

With respect to assets purchased from own funds the highest percentage of increase 450.63 was noticed in NP project of small farms and the lowest percentage of increase viz., nil was noticed in RW and RCW projects of small and medium farms respectively.

The study revealed that there was increase in the working capital requirement in all the farms except in farms purchasing power tillers.

With regard to change in cropping pattern, though no definite trend was noticed, the results of the study indicated the existence of substitution of rice for groundnut.

Capital budgeting using the IRR criterion was adopted in the study as a method of evaluating investment efficiency. The details of cost and returns were worked out for 20 years for minor-irrigation farms, 10 years for mechanized farms, and 15 years for reclamation farms. The benefits of the projects were assumed to flow from the second year in the case of mechanized farms, and from the third year in the reclamation farms. The results of the study revealed that IRR increased with increase in the size of the farms, indicating that large farms realised higher profits.

The higher rate of returns, in combination with the greater project outlay, provided a high net value of earnings for large farms. The increases in income per rupee invested in NP project worked out to Rs.0.53, 0.54 and 1.12 in the small, medium and large farms, respectively. The increase in income was higher where dry lands were converted into irrigated lands. The IRR in all the projects were higher than the institutional rate of lending viz., 11 per cent except in farms purchasing power tiller. The study revealed that while the IRR depended on the project outlay and associated costs, the returns were influenced by the changes in land type, cropping pattern and cropping intensity.

Among the minor-irrigation projects, NFR yielded highest IRR i.e., 43.78 per cent in small farms. However, the

IRR was higher for projects NP in large farms than in small farms because the new wells in large farms could be used fully whereas this was not so in small farms.

This indicated that heavy investment in new well projects in small farms was too expensive considering the small size of their operational holding and low proportion of area of dry lands in these farms.

Regarding deepening of well projects, it was undertaken only by medium and large farms to augment water potential in the farms. In this case also the IRR was higher in large farms than in medium farms. In small farms, there was no need for deepening of wells as there was adequate water to irrigate the existing area of the holdings. In case of pipe line projects, which were location specific, they were adopted only by medium farms and highest rate of return was noticed.

The IRR for tractor project was low and the study of the cash flow statement revealed that a sizeable portion of profit, about 43.57 per cent of the incremental income was contributed by custom service. This result implied that, for a positive and profitable returns from tractor project, the operational area of the farm should be larger, or alternatively, with scope for earning through custom service.

For power tiller farms the opportunity cost was negative in the absence of demand for custom service. Even then the investments on power tiller were made because of the need for substitution of permanent labour and bullock labour and small size of their holdings.

Of all the reclamation projects conversion of dry lands into garden lands appeared to be more profitable proposition. It was also noticed that conversion of dry lands to garden lands yielded higher rates of return, about 41.54 per cent in medium farms against 25.80 per cent in small farms implementing ROW project.

One of the objectives of the study was to examine the existing enterprise-mix and to determine the optimum enterprise mix in the pre and post-development situations. The present analysis was confined to minor-irrigation projects. Linear programming technique was used for this analysis and optimum plans for six specified situations, at the rate of two for each size group, were determined. The two situations were one with the existing resources in the pre-development period and the other with added resources in the post-development period.

Land, human labour, capital and irrigation water were identified as the scarce resources. Wet and garden land resources were considered with three seasonal restrictions and dry land with two seasonal restrictions. Labour resource

was considered as restriction in three seasons. Two periods of irrigation restriction and one period of capital restrictions were considered. All the crop activities that were grown in the sample farms were considered for the programme.

The results of linear programming analysis revealed that, in the pre-development situation, income could not be increased appreciably through reallocation of resources. In the post-development situation the income increased in all the farms due to resource development and allocation. With regard to the cropping pattern the optimum plans revealed that the farmers could limit the number of crops grown in their farms with resource limitation. Between the optimum plans of the two situations, the number of crops grown were higher in the post-development situation than in the pre-development situation. However, the number of crops grown in optimum plans in both the situations were much less than the number of crops grown in the existing plans. This was due to risk aversion factors which influenced farmers to go for large number of crops with expectation that even if some failed due to seasonal factors, some could escape and provide income. The practice also helped the farmers greater frequency of cash returns in the farms. The results also indicated that in the pre-development situation, the small and medium farms concentrated on dry land cultivation. Though growing of groundnut was not contemplated in the optimum plans except

in small farms in post-development situation, this crop was being grown by farmers in all the situations due to various reasons. The cropping intensity, except in small farms in pre-development situation, increased in all situations.

The human labour utilization increased in the post-development situation in all the farms. In the pre-development situation, the comparison between existing plan and optimum plan revealed that the labour use could be reduced by adopting the optimum pattern in small and medium farms. Utilization of the bullock labour increased in the post-development situation in all the farms. In the pre-development situation optimum crop-mix required less bullock labour in small and medium farms.

The MVP of the analysis indicated the following. Wet land in seasons 1 and 2, dry land in season 2, November human labour and capital were the critical resources in the small and medium farms in the pre-development situation. In the post-development situation in small farms wet land in season 1, garden land in seasons 1 and 2, November labour and capital were the most critical resources. In large farms dry land in season 2 was the only scarce resource both in the pre and post-development situations. In medium farms, wet land seasons 1 and 2, April irrigation water, capital and labour in all the three seasons were the critical

resources in the post-development situation. One important finding was that capital was the most restricting resource which would limit the crop-mix in the farms, especially, in the cultivation of third season crops.

Multiperiod programming was attempted in the study to examine the growth of farm firm during loan amortization period. The model covered 10 years divided into five periods each consisting of two year time lag. A development strategy was chosen which provided for one shot injection of outside capital financed by the land development bank. The amount of capital was assumed to be Rs.8,000. This amount was repayable in nine years in equated annual instalments at 11 per cent interest. It was further assumed that the saving generated in a period would be available and automatically transferred to next period for additional investment. The programme was considered for minor-irrigation purpose projects only. The constraint structure consisted of agricultural land, working capital, irrigation water, agricultural machinery, equipment and tools and investible funds for transfer or acquisition of resources.

In addition to the constraints structure as formulated in optimum crop plan analysis, the total availability of machinery, equipment and tools in value terms and investible funds were also considered for constraints. For investible

funds, the savings from the farm income after deducting consumption, debt repayments and fixed liabilities was taken into account, with due consideration for increased consumption expenditure overtime. Further more ceiling on land was imposed as a constraint because it was the policy of the government that an individual should not own land of more than 15 standard acres.

The activity set consisted of two parts: (i) crop activities - same as that included in the optimum crop plan analysis and (ii) resource activities specified for acquisition of resources out of investible funds.

The objective function was maximizing the present value of farm net income over the five periods.

The analysis of periodwise expansion of the farm firm by self investment during the course of five periods indicated that land could be increased by 202.60 per cent. Increase by direct purchase of garden and wet land was not preferred because purchase of dry land and conversion to garden land was more profitable than straight purchase of garden land. As regards the changes in the other variables considered for growth, the value of machinery, equipment and tools increased by Rs.16,266, the increase in working capital resource was Rs.22,378 and the improvements to irrigation structure increased the water potential from 92 acre inches to 99

acre inches. This analysis also confirmed that capital was the limiting resource which influenced the cropmix. The results also revealed that gross cropped area could be increased by 357.74 per cent and cropping intensity by 83.89 per cent during the programming period. The increase in net farm income per year was 267.94 per cent. Compound growth rates for some efficiency indicators worked out to 8.37 per cent for the farm size, 7.94 per cent for irrigation potential, 3.02 per cent for labour employment, 7.23 per cent for cropping intensity, 6.29 per cent for equity working capital and 8.94 per cent for net farm income. The above growth rates were worked out considering the situation existed at the threshold period (pre-development period) and at different programming periods.

Policy Implications

From the analyses of results of the present study certain issues focussing on the need for policy reorientation could be identified.

Among the projects introduced by the state and land land development banks for developing farms, the minor-irrigation project involving digging wells and deepening existing wells seem to have greater productive potential as could be seen from the relatively high IRR. This could be pursued with advantage further.

The project for conversion of dry lands into garden lands needs to be supplemented by projects for reclamation which includes levelling, bunding and laying field channels so that the water use efficiency could be improved. Suitable orientation in policy and strategies of state and financing institutions is necessary.

However, the capital budgeting analysis has revealed the IRR of investments in small farms had been relatively low. The main reason was that particularly of minor-irrigation development, small farms, because of small size of their operational area, could not utilize fully the water resources developed through investment. In order to improve the utilization capacity, it would seem necessary to develop an organizational frame work such as Co-operative lift irrigation societies for common ownership of water resources and individual management of them at the farm level.

Another problem at issue is the use of tractors. The results have shown the IRR of investment in tractor was not adequate in cases where tractor was used exclusively in the farm but, however, it was relatively higher when custom work was also taken up. This seems to confirm the general notion of unsuitability of tractor for the farm of the region. However, the farm output could also be increased by using tractor through higher cropping intensity. Thus, the real issue seems to be not the use of tractor per se but number of

tractors needed and that existed for a given farming area. The financing institutions must, wherever necessary encourage joint ownership of tractors with provision for custom service through appropriate lending instruments so that tractors could be used to their full capacity.

Finally, as new crop systems are envisaged technical, economic and institutional problems would emerge. They have to be solved through concerted measures by research, extension and market development. The need for strengthening technical/personnel at financing institutions to study the perspective changes their investment would generate and to develop appropriate lending strategies must be stressed.

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APPENDIX A

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SAMPLE FARMS - AREA, LOAN AMOUNT AND PROJECT

Sl. No.	Size of holding	Loan amount	Project code	Sl. No.	Size of holding	Loan amount	Project code
(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	ha	Rs.			ha	Rs.	
I.	<u>Minor-irrigation</u>						
1	0.61	3,500	N	26	0.77	4,000	NP
2	1.90	3,000	"	27	1.53	8,000	"
3	1.62	3,500	"	28	1.46	9,100	"
4	1.82	5,000	"	29	1.55	9,000	"
5	0.73	4,500	"	30	1.85	9,000	"
6	1.20	4,000	"	31	1.60	7,300	"
7	1.35	3,500	"	32	1.74	6,500	"
8	0.68	4,500	"	33	0.81	6,300	"
9	0.73	4,000	"	34	1.25	7,000	"
10	1.09	4,500	"	35	1.41	6,500	"
11	1.05	6,500	NP	36	1.58	7,700	"
12	1.43	6,400	"	37	0.60	6,000	"
13	1.11	5,500	"	38	1.92	7,000	"
14	1.26	9,000	"	39	0.61	8,500	"
15	1.26	5,000	"	40	1.50	8,000	"
16	0.84	8,500	"	41	1.72	11,000	NPL
17	0.78	6,500	"	42	1.25	8,900	NPR
18	1.98	7,500	"	43	0.70	5,500	"
19	0.91	8,000	"	44	2.55	8,200	NP
20	1.58	9,000	"	45	2.02	9,500	"
21	1.66	9,200	"	46	3.64	7,900	"
22	1.57	6,000	"	47	2.95	8,700	"
23	1.37	6,500	"	48	2.83	7,800	"
24	1.13	6,200	"	49	3.84	8,000	"
25	0.67	4,500	"	50	3.64	8,000	"

APPENDIX A (CONTINUED)

(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	ha	Rs.			ha	Rs.	
51	2.02	8,000	NP	76	2.79	6,750	L
52	2.02	8,300	"	77	2.67	7,000	"
53	3.91	9,000	"	78	2.96	6,500	"
54	2.51	8,500	"	79	5.40	6,000	N
55	2.23	9,000	"	80	5.66	6,000	"
56	2.46	8,000	"	81	4.85	8,400	NP
57	2.99	7,500	"	82	6.06	8,000	"
58	2.20	10,000	"	83	4.65	10,600	"
59	2.27	7,000	"	84	9.49	10,500	"
60	2.10	10,000	"	85	4.85	7,500	"
61	2.02	8,200	"	86	4.94	8,900	"
62	3.66	7,900	"	87	9.09	11,500	"
63	3.07	9,500	"	88	10.18	14,000	"
64	2.26	7,000	"	89	7.47	8,500	"
65	3.23	6,500	NPL	90	8.89	9,500	"
66	4.04	8,000	"	91	5.66	12,000	NPL
67	3.86	7,000	"	92	9.47	13,000	"
68	3.37	6,500	"	93	7.74	11,000	"
69	2.63	7,900	DP	94	13.74	20,000	"
70	2.83	4,100	"	95	4.52	5,000	D
71	2.02	7,000	"	96	6.82	7,000	DP
72	3.20	7,000	"	97	6.67	9,000	DPL
73	2.67	9,200	DL	98	6.67	8,000	"
74	3.81	6,100	"	99	8.14	13,000	DL
75	2.41	7,200	"	100	4.09	11,000	"

APPENDIX A (CONTINUED)

(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	ha	Rs.			ha	Rs.	
II. Mechanization							
1	15.23	38,300	MT	26	18.26	32,500	MT
2	17.11	37,800	"	27	23.75	36,500	"
3	11.19	35,100	"	28	21.59	39,700	"
4	9.62	32,500	"	29	36.22	41,500	"
5	8.59	37,000	"	30	23.07	31,600	"
6	14.34	30,000	"	31	6.44	11,000	MPT
7	36.54	32,000	"	32	6.72	11,500	"
8	17.52	36,500	"	33	12.13	11,000	"
9	46.86	40,300	"	34	6.91	9,500	"
10	5.97	35,400	"	35	6.18	9,000	"
11	8.92	37,800	"	36	10.34	10,400	"
12	12.92	34,500	"	37	6.11	9,500	"
13	13.20	30,800	"	38	7.60	10,000	"
14	9.68	33,600	"	39	8.51	9,500	"
15	30.86	38,100	"	40	6.18	10,000	"
16	24.38	31,500	"	41	9.64	10,500	"
17	11.62	41,200	"	42	9.87	11,000	"
18	11.93	30,400	"	43	6.48	9,200	"
19	23.64	33,500	"	44	11.73	10,800	"
20	6.07	28,600	"	45	7.42	9,500	"
21	10.99	30,000	"	46	6.46	11,000	"
22	12.07	36,300	"	47	6.49	10,600	"
23	15.46	38,600	"	48	9.49	9,000	"
24	18.16	34,500	"	49	6.55	9,000	"
25	14.69	33,600	"	50	8.34	9,000	"

APPENDIX A (CONTINUED)

(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	ha	Rs.			ha	Rs.	
III. Reclamation							
1	1.48	1,600	RD	26	0.64	3,725	RCW
2	0.81	3,100	"	27	0.93	4,000	"
3	1.62	3,000	"	28	0.68	2,500	"
4	1.43	2,100	"	29	3.67	5,100	RCG
5	1.04	2,700	"	30	3.24	4,600	"
6	1.29	2,000	"	31	3.08	4,900	"
7	1.47	3,000	"	32	3.84	7,500	"
8	0.71	1,700	"	33	2.10	7,000	"
9	1.49	2,100	RW	34	2.17	6,000	"
10	1.66	2,900	"	35	2.87	5,200	"
11	1.09	3,500	"	36	3.10	6,500	"
12	0.57	1,900	"	37	3.44	4,200	"
13	0.80	2,200	"	38	2.37	7,000	"
14	0.84	2,500	"	39	2.43	4,500	RCW
15	1.04	2,700	"	40	2.83	5,000	"
16	1.23	3,000	"	41	2.10	6,000	"
17	1.33	4,500	RCG	42	3.44	5,600	"
18	0.86	2,900	"	43	3.09	2,100	"
19	0.88	2,500	"	44	2.65	3,100	"
20	1.16	3,500	"	45	10.68	5,200	RD
21	0.84	3,600	"	46	8.84	6,300	"
22	1.27	4,200	"	47	6.86	5,800	"
23	0.70	1,500	RCW	48	5.54	6,300	"
24	1.15	4,500	"	49	7.89	5,000	RCW
25	0.66	4,200	"	50	4.00	4,000	"

APPENDIX B.1

Pre-, and Post-development cropping pattern in Small Farms investing in N Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	0.87	0.87
2. Garden land	-	0.24
3. Dry land	0.24	-
Total	1.11	1.11

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
11.	Rice	Dry + irrigated	1	Wet	0.64	0.24
2.	Rice	Irrigated	1	Wet	0.07	0.47
3.	Groundnut	Irrigated	1	Wet	-	0.12
4.	Rice	Irrigated	2	Wet	0.88	0.88
5.	Rice	Irrigated	3	Wet	-	0.21
6.	Groundnut	Irrigated	3	Wet	-	0.25
7.	Groundnut	Irrigated	1	Garden	-	0.13
8.	Rice	Irrigated	1	Garden	-	0.05
9.	Rice	Irrigated	2	Garden	-	0.19
10.	Rice	Irrigated	3	Garden	-	0.06
11.	Groundnut	Irrigated	3	Garden	-	0.13
12.	Rice	Dry	1	Dry	0.04	-
13.	Groundnut	Dry	1	Dry	0.06	-
14.	Ragi	Dry	2	Dry	0.13	-
Total					1.62	2.73

APPENDIX B.2

Pre-, and Post-development cropping pattern in Small Farms
in NP Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	0.52	0.52
2. Garden land	-	1.04
3. Dry land	1.04	-
Total	1.56	1.56

II. Cropping pattern

Sl. no.	Crops	Irrigated/Dry	Season	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.18	0.03
2.	Rice	Irrigated	1	Wet	0.07	0.24
3.	Groundnut	Irrigated	1	Wet	-	0.10
4.	Groundnut	Dry	1	Wet	0.03	-
5.	Rice	Irrigated	2	Wet	0.66	0.52
6.	Rice	Irrigated	3	Wet	-	0.07
7.	Groundnut	Irrigated	3	Wet	-	0.18
8.	Groundnut	Irrigated	1	Garden	-	0.41
9.	Rice	Irrigated	1	Garden	-	0.21
10.	Rice	Irrigated	2	Garden	-	1.04
11.	Rice	Irrigated	3	Garden	-	0.13
12.	Groundnut	Irrigated	3	Garden	-	0.39
13.	Rice	Dry	1	Dry	0.45	-
14.	Groundnut	Dry	1	Dry	0.40	-
15.	Ragi	Dry	2	Dry	0.11	-
Total					1.90	3.32

APPENDIX B.3

Pre-, and Post-development cropping pattern in Small Farm
investing in NPL Project

				hectare		
Land type/crops		Pre-dev.		Post-dev.		
<u>I. Land type</u>						
1.	Wet land	--		--		
2.	Garden land	--		1.72		
3.	Dry land	1.72		--		
Total		1.72		1.72		
<u>II. Cropping pattern</u>						
Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Garden	-	0.41
2.	Rice	Irrigated	1	Garden	-	0.81
3.	Rice	Irrigated	2	Garden	-	1.72
4.	Rice	Irrigated	3	Garden	-	0.41
5.	Groundnut	Irrigated	3	Garden	-	1.01
6.	Rice	Dry	1	Dry	1.72	-
7.	Ragi	Dry	2	Dry	0.41	-
Total					2.13	4.36

APPENDIX B.4

Pre-, and Post-development cropping pattern in Small Farms investing in NPR Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Garden land	--	0.98
2. Dry land	0.98	--
Total	0.98	0.98

II. Cropping pattern

Sl. No.	Crop	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Garden	--	0.63
2.	Rice	Irrigated	1	Garden	--	0.35
3.	Rice	Irrigated	2	Garden	--	0.98
4.	Groundnut	Irrigated	3	Garden	--	0.66
5.	Groundnut	Dry	1	Dry	0.98	--
6.	Ragi	Dry	2	Dry	0.35	--
Total					1.33	2.62

APPENDIX B.5

Pre-, and Post-development cropping pattern in Medium Farm
investing in NP Project

Land type/crops	hectare					
	Pre-dev.	Post-dev.				
<u>I. Land type</u>						
1. Wet land	1.14	1.14				
2. Garden land	--	1.20				
3. Dry land	1.60	0.40				
Total	2.74	2.74				
<u>II. Cropping pattern</u>						
Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	0.05	0.77
2.	Rice	Irrigated + Dry	1	Wet	0.55	0.27
3.	Rice	Irrigated	1	Wet	0.05	0.41
4.	Rice	Irrigated	2	Wet	1.14	1.02
5.	Rice	Irrigated	3	Wet	0.06	1.94
6.	Groundnut	Irrigated	3	Wet	0.07	0.18
7.	Groundnut	Irrigated	1	Garden	-	0.30
8.	Rice	Irrigated	1	Garden	-	0.37
9.	Rice	Irrigated	2	Garden	-	1.15
10.	Rice	Irrigated	3	Garden	-	0.13
11.	Groundnut	Irrigated	3	Garden	-	0.48
12.	Rice	Dry	1	Dry	0.58	0.19
13.	Groundnut	Dry	1	Dry	1.04	0.22
14.	Ragi	Dry	2	Dry	0.28	--
Total					3.82	7.43

APPENDIX B.6

Pre-, and Post-development cropping pattern in Medium Farms
investing in NPL Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	0.98	0.98
2. Garden land	--	1.78
3. Dry land	2.65	0.87
Total	3.63	3.63

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Irrigated	1	Wet	0.73	0.73
2.	Rice	Irrigated	2	Wet	0.98	0.98
3.	Groundnut	Irrigated	3	Wet	0.30	0.30
4.	Groundnut	Irrigated	1	Garden	--	0.76
5.	Rice	Irrigated	1	Garden	--	0.41
6.	Rice	Irrigated	2	Garden	--	1.77
7.	Rice	Irrigated	3	Garden	--	0.10
8.	Groundnut	Irrigated	3	Garden	--	0.86
9.	Groundnut	Dry	1	Dry	2.09	0.56
10.	Rice	Dry	1	Dry	0.56	--
11.	Ragi	Dry	2	Dry	0.61	--
Total					5.27	6.47

APPENDIX B.7

Pre-, and Post-development cropping pattern in Medium Farms
Investing in DP Project

		hectare				
Land type/crops		Pre-dev.	Post-dev.			
<u>I. Land type</u>						
1.	Wet land	2.67	2.67			
<u>II. Cropping pattern</u>						
Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	1.42	0.20
2.	Rice	Irrigated	1	Wet	-	1.32
3.	Groundnut	Irrigated	1	Wet	-	0.20
4.	Rice	Irrigated	2	Wet	2.67	2.67
5.	Rice	Irrigated	3	Wet	-	0.61
6.	Groundnut	Irrigated	3	Wet	-	0.51
Total					4.09	5.51

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APPENDIX B.8

Pre-and Post-development cropping pattern in Medium Farms
investing in DPL Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	2.61	2.61
2. Garden land	—	0.35
3. Dry land	0.35	-
Total	2.96	2.96

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	-	0.61
2.	Rice	Irrigated	1	Wet	1.08	1.08
3.	Rice	Irrigated	2	Wet	2.61	2.61
4.	Rice	Irrigated	3	Wet	-	0.74
5.	Groundnut	Irrigated	3	Wet	1.08	0.94
6.	Groundnut	Irrigated	1	Garden	-	0.35
7.	Rice	Irrigated	2	Garden	-	0.35
8.	Groundnut	Dry	1	Dry	0.35	-
Total					5.12	6.68

APPENDIX B.9

Pre-and Post-development cropping pattern in Medium Farms investing in L Project

Land type/crops	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	1.86	1.97
2. Garden land	-	0.83
3. Dry land	0.94	-
Total	2.80	2.80

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.54	0.66
2.	Rice	Irrigated	1	Wet	1.03	1.03
3.	Groundnut	Irrigated	1	Wet	-	0.27
4.	Rice	Irrigated	2	Wet	1.85	1.97
5.	Rice	Irrigated	3	Wet	-	0.27
6.	Groundnut	Irrigated	3	Wet	1.15	1.15
7.	Groundnut	Irrigated	1	Garden	-	0.37
8.	Rice	Irrigated	1	Garden	-	0.36
9.	Rice	Irrigated	2	Garden	-	0.83
10.	Groundnut	Irrigated	3	Garden	-	0.44
11.	Rice	Dry	1	Dry	0.44	-
12.	Groundnut	Dry	1	Dry	0.37	-
13.	Ragi	Dry	2	Dry	0.16	-
Total					5.54	7.35

APPENDIX B.10

Pre-and Post-development cropping pattern in Large Farms investing in N Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	3.82	3.82
2. Garden land	-	1.72
3. Dry land	1.72	-
Total	5.54	5.54

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.81	0.81
2.	Rice	Irrigated	2	Wet	3.82	3.82
3.	Groundnut	Irrigated	1	Garden	-	1.62
4.	Rice	Irrigated	2	Garden	-	1.62
5.	Groundnut	Irrigated	3	Garden	-	1.21
6.	Groundnut	Dry	1	Dry	1.72	-
7.	Ragi	Dry	2	Dry	0.91	-
Total					7.26	9.08

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APPENDIX B.11

Pre-and Post-development cropping pattern in Large Farms
investing in NP Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
I. Land type		
1. Wet land	3.54	3.54
2. Garden land	0.42	1.66
3. Dry land	3.10	1.86
Total	7.06	7.06

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.57	1.89
2.	Rice	Irrigated	1	Wet	1.91	0.58
3.	Groundnut	Irrigated	1	Wet	0.36	-
4.	Rice	Irrigated	2	Wet	2.84	3.54
5.	Rice	Irrigated	3	Wet	0.45	0.30
6.	Groundnut	Irrigated	3	Wet	0.89	0.20
7.	Groundnut	Irrigated	1	Garden	0.45	-
8.	Rice	Irrigated	1	Garden	0.52	0.42
9.	Rice	Irrigated	2	Garden	1.66	0.42
10.	Rice	Irrigated	3	Garden	0.28	-
11.	Groundnut	Irrigated	3	Garden	0.42	0.20
12.	Rice	Dry	1	Dry	1.23	1.48
13.	Groundnut	Dry	1	Dry	0.63	1.61
14.	Ragi	Dry	2	Dry	0.26	0.30
Total					12.47	10.94

APPENDIX B.12

Pre-and Post-development cropping pattern in Large Farms investing in NPL Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	4.48	4.48
2. Garden land	0.63	1.89
3. Dry land	3.36	2.10
Total	8.47	8.47

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Irrigated	1	Wet	1.21	2.37
2.	Rice	Irrigated	2	Wet	4.21	2.37
3.	Rice	Irrigated	3	Wet	0.20	0.91
4.	Groundnut	Irrigated	3	Wet	-	1.06
5.	Rice	Dry + Irrigated	1	Wet	1.82	1.21
6.	Groundnut	Irrigated	1	Garden	0.24	0.62
7.	Rice	Irrigated	1	Garden	0.39	1.17
8.	Rice	Irrigated	2	Garden	0.63	1.89
9.	Rice	Irrigated	3	Garden	0.15	0.71
10.	Groundnut	Irrigated	3	Garden	0.47	1.06
11.	Groundnut	Dry	1	Dry	1.52	1.09
12.	Rice	Dry	1	Dry	2.55	0.35
13.	Ragi	Dry	2	Dry	0.35	1.71
Total					13.74	16.52

Appendix B.13
Pre-and Post-development cropping pattern in Large Farms
investing in D Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
I. Land type		
1. Wet land	4.13	4.13
2. Garden land	--	--
3. Dry land	0.40	0.40
Total	4.53	4.53

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	-	1.70
2.	Rice	Irrigated	1	Wet	0.81	0.81
3.	Rice	Irrigated	2	Wet	4.05	4.05
4.	Rice	Dry + Irrigated	1	Wet	1.62	-
5.	Groundnut	Irrigated	3	Wet	-	1.62
6.	Groundnut	Dry	1	Dry	0.40	0.40
Total					6.88	8.58

APPENDIX B.14

Pre- and Post-development cropping pattern in Large Farms investing in DP Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	3.94	3.94
2. Garden land	-	2.02
3. Dry land	2.88	0.86
Total	6.82	6.82

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	1.30	1.30
2.	Rice	Irrigated	1	Wet	2.53	2.53
3.	Rice	Irrigated	2	Wet	3.94	3.94
4.	Rice	Irrigated	3	Wet	0.91	0.91
5.	Groundnut	Irrigated	3	Wet	1.62	1.62
6.	Groundnut	Irrigated	1	Garden	-	1.21
7.	Rice	Irrigated	2	Garden	-	2.02
8.	Groundnut	Irrigated	3	Garden	-	1.21
9.	Rice	Dry	1	Dry	2.89	0.86
Total					13.19	15.60

APPENDIX B.15

Pre- and Post-development cropping pattern in Large Farms
investing in DPL Project

Land type/Crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	4.18	4.18
2. Garden land	0.40	1.65
3. Dry land	2.09	0.84
Total	6.67	6.67

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	2.50	2.09
2.	Rice	Irrigated	1	Wet	0.81	2.23
3.	Rice	Irrigated	2	Wet	4.18	4.18
4.	Rice	Irrigated	3	Wet	-	1.21
5.	Groundnut	Irrigated	3	Wet	-	1.82
6.	Groundnut	Irrigated	1	Garden	-	1.65
7.	Rice	Irrigated	2	Garden	-	1.65
8.	Groundnut	Irrigated	3	Garden	-	1.65
9.	Groundnut	Dry	1	Dry	0.81	-
Total					8.30	16.48

APPENDIX B.16

Pre-and Post-development cropping pattern in Large Farms
investing in DL Project

Land type/crops	hectare					
	Pre-dev.	Post-dev.				
<u>I. Land type</u>						
1. Wet land	3.48	3.48				
2. Garden land	-	1.23				
3. Dry land	2.65	1.42				
Total	6.13	6.13				
<u>II. Cropping pattern</u>						
Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	2.44	2.44
2.	Rice	Irrigated	1	Wet	-	-
3.	Rice	Irrigated	2	Wet	3.48	3.48
4.	Rice	Irrigated	3	Wet	-	-
5.	Groundnut	Irrigated	3	Wet	-	0.61
6.	Groundnut	Irrigated	1	Garden	-	-
7.	Rice	Irrigated	1	Garden	-	0.20
8.	Rice	Irrigated	2	Garden	-	1.21
9.	Rice	Irrigated	3	Garden	-	0.20
10.	Groundnut	Irrigated	3	Garden	-	0.63
11.	Groundnut	Dry	1	Dry	1.30	1.10
12.	Rice	Dry	1	Dry	1.15	0.34
13.	Ragi	Dry	2	Dry	0.40	0.34
Total					8.77	10.55

APPENDIX B.17

Pre- and Post-development cropping pattern in Large Farms investing in MT Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	8.39	8.39
2. Garden land	0.93	0.93
3. Dry land	8.38	8.38
Total	17.70	17.70

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	4.05	6.07
2.	Rice	Irrigated	1	Wet	2.02	2.02
3.	Rice	Irrigated	2	Wet	8.39	8.39
4.	Rice	Irrigated	3	Wet	0.81	-
5.	Groundnut	Irrigated	3	Wet	2.02	4.05
6.	Groundnut	Irrigated	1	Garden	0.93	0.93
7.	Rice	Irrigated	2	Garden	0.93	0.93
8.	Groundnut	Irrigated	3	Garden	0.93	0.93
9.	Rice	Dry	1	Dry	2.43	4.05
10.	Groundnut	Dry	1	Dry	2.43	4.05
Total					24.94	31.42

APPENDIX B.18

Pre- and Post-development cropping pattern in Large Farms investing in MPT Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	4.70	4.70
2. Garden land	1.49	1.49
Total	6.19	6.19

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Irrigated	1	Wet	4.70	4.70
2.	Rice	Irrigated	2	Wet	4.70	4.70
3.	Rice	Irrigated	3	Wet	1.21	1.21
4.	Groundnut	Irrigated	3	Wet	1.62	1.62
5.	Groundnut	Irrigated	1	Garden	1.49	1.49
6.	Rice	Irrigated	2	Garden	1.49	1.49
7.	Groundnut	Irrigated	3	Garden	1.49	1.49
Total					16.70	16.70

APPENDIX B.19

Pre- and Post-development cropping pattern in Small Farms
investing in RD Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
I. <u>Land type</u>		
1. Wet land	0.12	0.12
2. Dry land	1.11	1.11
Total	1.23	1.23

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.05	0.05
2.	Rice	Irrigated	1	Wet	0.04	0.04
3.	Rice	Irrigated	2	Wet	0.12	0.12
4.	Groundnut	Dry	1	Dry	0.66	0.41
5.	Rice	Dry	1	Dry	0.40	0.76
6.	Ragi	Dry	2	Dry	0.13	0.13
Total					1.40	1.51

APPENDIX B.20

Pre- and Post-development cropping pattern in Small Farms
investing in RW Project

		hectare				
Land type/crops		Pre-dev.	Post-dev.			
<u>I. Land type</u>						
1.	Wet land	1.09	1.09			
<u>II. Cropping pattern</u>						
Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.60	0.53
2.	Rice	Irrigated	1	Wet	0.08	0.33
3.	Rice	Irrigated	2	Wet	0.89	1.09
Total					1.57	1.95

APPENDIX B.21

Pre- and Post-development cropping pattern in Small Farms
investing in RCG Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Garden land	0.70	1.06
2. Dry land	0.36	-
Total	1.06	1.06

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Season	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Garden	0.32	0.62
2.	Rice	Irrigated	1	Garden	0.35	0.43
3.	Rice	Irrigated	2	Garden	0.70	1.06
4.	Rice	Irrigated	3	Garden	0.07	0.13
5.	Groundnut	Irrigated	3	Garden	0.48	0.56
6.	Groundnut	Dry	1	Dry	0.24	-
7.	Rice	Dry	1	Dry	0.12	-
Total					2.28	2.80

APPENDIX B.22

Pre- and Post-development cropping pattern in Small Farms
investing in RCW Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	0.43	0.79
2. Dry land	0.36	-
Total	0.79	0.79

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.20	0.56
2.	Rice	Irrigated	1	Wet	0.23	0.23
3.	Rice	Irrigated	2	Wet	0.43	0.79
4.	Rice	Dry	1	Dry	0.36	-
Total					1.22	1.58

APPENDIX B.23

Pre- and Post-development cropping pattern in Medium Farms
investing in RCG Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	1.02	1.02
2. Garden land	0.87	1.62
3. Dry land	1.10	0.35
Total	2.99	2.99

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	0.55	0.55
2.	Rice	Irrigated	1	Wet	0.42	0.42
3.	Rice	Irrigated	2	Wet	1.02	1.02
4.	Groundnut	Irrigated	1	Garden	0.38	1.02
5.	Rice	Irrigated	1	Garden	0.49	0.61
6.	Rice	Irrigated	2	Garden	0.87	2.44
7.	Rice	Irrigated	3	Garden	0.28	0.21
8.	Groundnut	Irrigated	3	Garden	0.49	1.14
9.	Groundnut	Dry	1	Dry	0.73	0.12
10.	Rice	Dry	1	Dry	0.37	0.23
Total					5.60	7.76

APPENDIX B.24

Pre- and Post-development cropping pattern in Medium Farms
investing in RCW Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	2.46	2.76
2. Dry land	0.30	-
Total	2.76	2.76

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	-	0.16
2.	Rice	Dry + Irrigated	1	Wet	1.26	1.40
3.	Rice	Irrigated	1	Wet	1.20	1.20
4.	Rice	Irrigated	2	Wet	2.46	2.76
5.	Rice	Irrigated	3	Wet	0.64	0.61
6.	Groundnut	Irrigated	3	Wet	0.74	0.84
7.	Rice	Dry	1	Dry	0.17	-
8.	Groundnut	Dry	1	Dry	0.13	-
Total					6.60	6.97

APPENDIX B.25

Pre- and Post-development cropping pattern in Large Farms investing in RD Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	3.56	3.56
2. Dry land	4.42	4.42
Total	7.98	7.98

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Groundnut	Irrigated	1	Wet	0.91	0.91
2.	Rice	Dry + Irrigated	1	Wet	1.11	1.11
3.	Rice	Irrigated	1	Wet	0.71	0.71
4.	Rice	Irrigated	2	Wet	3.56	3.56
5.	Rice	Irrigated	3	Wet	0.51	0.51
6.	Groundnut	Irrigated	3	Wet	1.02	1.02
7.	Rice	Dry	1	Dry	1.74	3.10
8.	Groundnut	Dry	1	Dry	2.68	1.32
9.	Ragi	Dry	2	Dry	0.71	1.21
Total					12.95	13.45

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APPENDIX B.26

Pre- and Post-development cropping pattern in Large Farms
investing in RCW Project

Land type/crops	hectare	
	Pre-dev.	Post-dev.
<u>I. Land type</u>		
1. Wet land	5.44	5.86
2. Dry land	0.42	-
Total	5.86	5.86

II. Cropping pattern

Sl. No.	Crops	Irrigated/Dry	Seasons	Land type	Pre-dev.	Post-dev.
1.	Rice	Dry + Irrigated	1	Wet	2.43	2.83
2.	Rice	Irrigated	1	Wet	1.62	1.62
3.	Rice	Irrigated	2	Wet	5.44	5.86
4.	Rice	Irrigated	3	Wet	1.62	1.62
5.	Groundnut	Irrigated	3	Wet	2.43	2.83
6.	Rice	Dry	1	Dry	0.42	-
Total					13.96	14.96