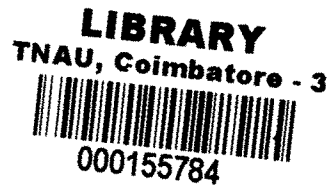


**IMPACT OF KERALA HORTICULTURE DEVELOPMENT  
PROGRAMME ON RESOURCE USE EFFICIENCY IN BANANA  
(NENDRAN) PRODUCTION IN ERNAKULAM DISTRICT**

Thesis submitted in part fulfilment of the requirements  
for the degree of Master of Science (Agriculture) in Agricultural Economics  
to the Tamil Nadu Agricultural University, Coimbatore - 3..

By

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1999

## CERTIFICATE

This is to certify that the thesis entitled "IMPACT OF KERALA HORTICULTURE DEVELOPMENT PROGRAMME ON RESOURCE USE EFFICIENCY IN BANANA (NENDRAN) PRODUCTION IN ERNAKULAM DISTRICT" submitted in part fulfilment of the requirements for the award of the degree of MASTER OF SCIENCE (AGRICULTURE) in AGRICULTURAL ECONOMICS to the Tamil Nadu Agricultural University, Coimbatore is a bonafide record of research work carried out by Mr.SREEKUMAR, K. under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

Date : 19.5.99  
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(SREEKUMAR, K.)

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# Introduction

## CHAPTER I

### INTRODUCTION

Importance of fruits in human diet is universally recognized. They are the chief source of vitamins, without which the human body cannot maintain proper health and resistance to diseases. They also contain mineral salts, the deficiency of which can lead to disturbances of metabolism leading to ill health. Fruits are also considered to possess certain medicinal values. But, many people still regard fruits as a luxury rather than a food which should form part of the daily diet.

#### **The Banana Economy :**

The production of banana in the world is estimated at 49.6 million tonnes. The developing countries account for about 98 per cent of the world production of banana and the share of India is 14.1 per cent. The other major producers are Brazil, Philippines, Indonesia and China. In India, the state of Maharashtra accounts for 27 per cent of the total production, followed by Tamil Nadu with 20 per cent. The following states namely, Gujarat, Madhya Pradesh and Andhra Pradesh account for 29.0 per cent and the rest (24 per cent) is produced in all other states<sup>1</sup>. This

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<sup>1</sup>Gulathi, A., A. Sharma, K. Sharma, S. Das and V. Chhabra, **Export Competitiveness of Selected Agricultural Commodities**, (New Delhi : National Council of Applied Economic Research, 1994), PP : 133-135.

indicates the fact that Kerala is one of the minor producers at national level though banana is an important component of the regular diet of the people in the state.

### **The Importance of Banana :**

The earliest reference to banana is found in the Hindu classics. A picturesque description of the banana plantation around the green bower of "Valmiki Maharishi" is given in the "Ramayana". The generic name of banana-musa, was derived from the Arabic word "mouxh". Presumably, bananas were known to the Arabs from very early times and it appears in "Holy Quran" as the "tree of paradise" which is equivalent to the "tree of knowledge" of christian tradition. Accordingly, the specific name was given as "Paradisiaca". In plinius's "Historia Naturalis", banana is mentioned as the major item of food of Indian sages. The great historian Disraeli mentioned banana as the most delicious thing in the world<sup>2</sup>.

### **Nutritive value of Banana :**

Bananas play a major role as a complementary food in human diet. It provides a more balanced diet at a relatively cheaper cost than many other fruits. It contains good amount of nutrients which are easily digested

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<sup>2</sup>Aravindakshan, M. and K. Pushkaran., **Banana compendium**, (Thrissur : Directorate of Extension, Kerala Agricultural University, 1996), p.1.

and absorbed. It has a calorific value ranging from 67 to 137 calories per 100 gram. The average nutrient composition of banana fruit is as follows; moisture - (70 per cent), carbohydrate - (27 per cent), protein - (1.2 per cent), ash - (0.9 per cent), crude fibre - (0.5 per cent), fat - (0.3 per cent), phosphorus - (290 ppm), calcium - (80 ppm), iron - (6 ppm), carotene - (0.5 ppm), riboflavin - (0.5 ppm), niacin - (7 ppm), and ascorbic acid - (120 ppm).

The following are the other important uses of banana. The nendran variety is very popular in the preparation of chips. Banana figs, which are sun dried slices of the fruits with fig like consistency are commonly prepared in many countries. Some varieties are used for preparing baby foods. Banana ash is highly alkaline and therefore can check acidity in stomach. 'Chips making' is considered as a small scale industry in few states of Southern India.

### **The case of Banana in Kerala**

To an average Keralite, fruit means 'banana'. As such, it is an integral part of the homesteads, a unique feature of Kerala. Every part of the crop is useful and the state is famous for its multitudes of banana cultivars. Banana is often referred as poorman's apple but it is equally liked by both rich and the poor. The availability of the crop all through the year has made it an inevitable necessity to the people. The soil type in Kerala is best suited for banana cultivation. Most of the farmers however,

give much importance for the cultural practices. Therefore, banana production in Kerala is not able to meet the demand at State level and presently the state's requirement is met by the import from different districts of Tamil Nadu.

The area, production and productivity of banana (nendran) in different districts of Kerala during 1995-96 are furnished in Table-1.

Though the area under banana in Kerala is very vast, the production is relatively lower, since banana is grown as intercrop in most of the areas. Unlike in states such as Tamil Nadu, the extensive banana tracts are not common in Kerala. These are the major reasons attributed to the low productivity of banana in Kerala. The best suited soil, climate, good market and export potential are not taken advantage of, by the farmers cultivating banana in the state.

### **The Kerala Horticulture Development Programme (KHDP)**

The high value horticultural crops form a strong base not only to the economy of the farmers but also to the economy of the state. Kerala, the state which is blessed with fertile soil, profuse rains and good sunshine is ideal for developing a horticultural base. Keeping this in view, the Kerala Horticultural Development Programme (KHDP) funded by the European Economic Community (EEC) and the Government of Kerala (GOK) was launched in 1993 with a total out lay of Rs.165 crores with the aim of making horticulture a profitable business.

**Table 1. Area, production and productivity of banana (nendran) in different districts of Kerala (1995-96)**

District	Area (hectare)	Production (tonnes)	Productivity (tonnes/hectare)
Thiruvananthapuram	1094	14130	12.91
Kollam	989	13328	13.48
Pathanamthitta	1308	18559	14.19
Alappuzha	1110	5929	14.46
Kottayam	1565	25815	16.49
Idukki	917	14918	16.27
Ernakulam	2529	33438	13.22
Thrissur	2128	33461	15.72
Palakkad	4413	53387	12.09
Malappuram	4738	59885	12.64
Kozhikode	1143	16558	14.49
Wayanad	2790	39522	14.16
Kannur	1614	24180	14.98
Kasaragod	629	9807	15.59
<b>Total</b>	<b>26967</b>	<b>362917</b>	<b>13.46</b>

Source : Directorate of Economics & Statistics, Govt. of Kerala, Thiruvananthapuram.

✓ R

**a) Profile of the Kerala Horticulture Development Programme:**

The Kerala Horticulture Development Programme was commissioned, as per the Financing Agreement signed on 17th January, 1992 at Brussels by the Government of India and the Commission of European Communities. The programme covers the following components. (i) Formation of Self Help Groups (SHGs) to promote organisational and management skills among farmers, (ii) Extending credit through nationalised banks by creating a revolving fund, to simplify access to credit and to make adequate credit available to the farmers, (iii) Promotion of marketing efforts by creating Field Centres to provide market information and to reduce marketing cost for the realisation of better prices, (iv) Research backup to promote development of appropriate technology packages to promote pest and disease surveillance activities to prevent possible outbreaks and to prevent indiscriminate and overuse of pesticides. (v) Supply of quality seeds. (vi) Training of farmers and extension functionaries based on need and feed back and (vii) Promoting agro processing. Under the Programme a Seed Processing unit was established at Alathur in Palghat District and a Fruit Processing unit was established at Nadukkara, near Muvattupuzha in Ernakulam District. The Programme is designed as a Pilot Project to develop replicable models to introduce in other places. The programme became operational from 26th November, 1993 to be implemented over a period of six years.

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The total estimated cost as per the Financing Agreement is European Currency 36.7 million. The Agency responsible for the implementation of the Programme is the Programme Directorate based at Cochin under the overall guidance and supervision of the Steering Committee headed by the Chief Secretary, Government of Kerala. Necessary funds are made available for the implementation of the Programme from Government of Kerala through budgetary allocations.

The KHDP aims to improve and stabilise the income of Kerala horticulture farmers through:

(i) the provision of good quality planting material, introduction of appropriate cultural practices/packages, easy and timely access to agricultural credit and establishment of a modern seed processing plant.

(ii) the improvement of the marketing system for fresh horticultural products and the development of modern fruit processing industry.

The crops covered under KHDP are; bitter gourd, snake gourd, amaranthus, cucumber, lady's finger, coccinia, brinjal, cowpea and chilly under vegetables and mango, Pineapple and banana (nendran) under fruits.

### **The problem focus**

Banana (nendran) is the major fruit crop covered under KHDP. It is one of the crops covered under the programme since the commencement of phase-1 of the project in the year 1993. The implicit focus under the

project with specific reference to banana is to bring more area under systematic cultivation of banana to increase productivity and there by production. The project is under implementation for more than five years since its inception in 1993.

In Kerala, more than 25% of area under banana is under nendran variety. It is the only variety of banana cultivated commercially in a systematic manner.

Therefore, the present study is taken up primarily to evaluate the impact of the project interms of expansion of area under banana (nendran), adoption of recommended technologies, improved levels of income and levels of resource-use-efficiency and also the benefits derived from the credit and marketing facilities made available under the project.

## **HYPOTHESES**

- i) The farmers covered under KHDP are relatively more efficient in utilization of various inputs in banana (nendran) cultivation.
- ii) The farmers covered under KHDP had easy access to credit.
- iii) The farmers covered under KHDP could realise better prices for their produce.

## **OBJECTIVES**

The overall objective of the study is to assess the benefits that accrued to the farmers, interms of optimum use of resources, easy and

adequate credit and better price realised through the marketing arrangements made under KHDP.

The specific objectives are,

i) To assess the difference in the crop composition, with specific reference to the area under banana (nendran) for the beneficiary and non-beneficiary farmers.

ii) To assess the extent of adoption of production technologies advocated under KHDP for banana (nendran).

iii) To assess the extent of use and benefit of credit and marketing facilities created under KHDP for banana (nendran).

iv) To assess the levels of income for the beneficiary and non-beneficiary farmers.

v) To assess the resource use efficiency in cultivation of banana (nendran) by the beneficiary and non beneficiary farmers.

### **SCOPE OF THE STUDY**

The study is expected to help the banana growers to assess the level of factor productivity and rationalise input use in banana (nendran) cultivation to obtain better yield and income. It will also help the KHDP programme management to identify bottle necks if any especially in the production process and render appropriate advice to the farmers by imparting suitable training to the officers working under the project.

## **LIMITATIONS OF THE STUDY**

The possible recall bias of the respondents and absence of proper farm records with them were the main limitations. But these were minimised by suitable interactions with farmers as well as cross checks made then and there with departmental staff during the survey. The time and financial constraints could permit selection of only one district for the microlevel study.

## **ORGANISATION OF THE THESIS**

The thesis is organised in six chapters as given below:

**Chapter I :** The importance, the hypotheses, the objectives, scope and limitations of the study are presented.

**Chapter II :** Concepts used in the present study and review of earlier studies are discussed.

**Chapter III :** The sources of data, sampling design, method of data collection, specification of variables and tools of analysis are presented.

**Chapter IV :** The description of the study area is presented.

**Chapter V :** The results are discussed and interpreted

**Chapter VI :** The summary and conclusion with policy implications are presented.

# Concepts & Review

## CHAPTER II

### CONCEPTS AND REVIEW

(A comprehensive review of literature pertaining to the study is essential for the better understanding of the concepts, design of the study and analytical frame work. A review of various concepts and results of important studies, is presented below, under the following heads.

- (i) Definition of concepts
- (ii) Review of past studies

#### Definition of concepts

#### Impact analysis

Tewari and Sharma<sup>3</sup> assessed the impact of technical change in terms of significant differences in input-output relationships on different types of farms. They computed the cost and returns at farm level for the project and non-project area farms, to compare the resource-use efficiency for the different inputs used and the gross income realised in the two areas.

Sharma<sup>4</sup> *et al.* assessed the impact of the lab to land programme in terms of changes in production and productivity, input use, resource use efficiency and net returns.

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<sup>3</sup>Tewari, S.C. and R.K. Sharma, "Effect of Technological Change on Hill Agriculture", **Himachal Journal of Agricultural Research**, 10(2) : 53-60, 1984.

<sup>4</sup>Sharma, H.R., S.K. Sharma and R.C. Bhardwaj, "Impact of Lab-to-Land Programme - a Study of Marginal Farms", **Agricultural Situation in India**, 41(7) : 547-550, 1986. ]

(Lata<sup>5</sup> *et al.* examined the impact of the Lab to Land programme on the families of two villages by examining the changes in pattern of input use, productivity, net returns and resource use efficiency).

Rao<sup>6</sup> *et al.* quantified the impact of agricultural commercialization on the utilization of resources in Prakasam district of Andhra Pradesh. Separate Cobb-Douglas production functions were estimated for the lesser commercialised and highly commercialized sample farms independently, to study the resource use efficiency, considering variables such as, area under commercial crops, value of marketed surplus and expenditure on improved seeds, fertilizers, pesticides, machine power and the human labour and the gross income of the farms.

Mattigatti<sup>7</sup> *et al.* evaluated the impact of Operation Flood by examining the resource productivity in the production of cow milk in Dharwad district of Karnataka by covering a sample consisting of 65 members of the cooperatives participating in the programme and 65 non-members.

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<sup>5</sup>Lata, S., Y. Agnihotri and S.P. Mittal, "Impact of Lab to Land Programme in Shivalik Foot Hill Villages - a Case Study", **Agricultural Situation in India**, 44(9) : 695-699, 1989.] ✓

<sup>6</sup>Rao, N.C., V.T. Raju, D.V.S. Rao and S.M. Shareef, "Impact of Commercialisation of Agriculture on Resource Use Efficiency in Prakasam District of Andhra Pradesh", **Economic Affairs**, 36(4) : 214-222, 1991.

<sup>7</sup>Mattigatti, R., H.G.S. Murthy, G.K. Hiremath and S. Mallikarjunappa, "Resource Productivity in Cow Milk Production - an Impact of Operation Flood Programme", **Indian Cooperative Review**, 30(2) : 145-153, 1993.

The Danish development associates<sup>8</sup> opined that the combined effects (positive and negative) of an intervention should be evaluated in terms of broad development objectives, such as poverty alleviation, gender equity and environmental protection. According to them the impact assessment has to include the discussion of the hierarchy of objectives and one should ensure that a project has a satisfactory impact in relation to all its development objectives.

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(In the present study, the impact of the KHDP was evaluated by considering the resource use efficiency for different inputs, the mean technical efficiency by estimating a frontier production function and also by considering differences in the extent of adoption of various technologies, utilization of credit and marketing facilities made available or created under the project and the farm family income realised.)

The other important concepts followed by different authors, such as, production, production function, resource-use-efficiency and technical efficiency are discussed below.

### **Production Function**

(Bishop and Toussiant<sup>9</sup> defined production as a process whereby some goods and services called inputs are transformed into other goods and services called outputs.)

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<sup>8</sup>Ministry of Foreign Affairs, Evaluation Report - Agricultural Sector Evaluation, Danide, 1: 5, 1994.

<sup>9</sup>Bishop, C.E. and W.D. Toussiant, **Agricultural Economic Analysis**, (Newyork : JohnWiley & Sons Inc., 1958), p.29.

✓

Nerin<sup>10</sup> stated the application of resources-land, labour, capital and enterprises to the creation of new wealth as production.

According to Ahuja<sup>11</sup> the word 'production' in economics not merely covered effecting physical transformation in the matter, it also included the rendering of services such as transportation, finance, wholesale and retail trade.

Stigler<sup>12</sup> defined production function as the relationship between the inputs or production services per unit of time and output per unit of time.

According to Heady and Dhillon<sup>13</sup> the term production function is defined as the relationship between the input or factor services and output of a product.

Kaplin<sup>14</sup> defined the production function as the relationship between quantities of inputs and output. It was further emphasised that it

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<sup>10</sup>Nerin, E.T., **A text book of Economic Analysis**, (London: Macmillan Education Ltd., 1971), p.3.

<sup>11</sup>Ahuja, H.L., **A Text book of Modern Economics**, (New Delhi : S.Chand & Company Ltd., 1979), p.279.

<sup>12</sup>Stigler, J.C., **Price Theory**, (Tokyo: Mc.Graw Hill Kogakusha Ltd., 1947), p. 109.

<sup>13</sup>Heady, E.O. and J.L. Dhillon, **Agricultural Production Functions**, (Ames: Iowa State University Press, 1961), p. 228.

<sup>14</sup>Kaplin, H.T., **Micro-Economic Analysis-Welfare and Efficiency in Private and Public Sector**, (New York: Harper and Row Publishers, 1971), p.89.

would give the relationship between the quantities of various inputs that could be used to produce a given output and the quantity of output that could be produced with a given set of inputs.

Handerson and Quant<sup>15</sup> described production function as the quantity of output as a function of quantities of variable inputs. Accordingly, the production function is defined only for non-negative values of inputs and outputs.

Bishop and Toussiant<sup>16</sup> defined production function as the mathematical relationship describing the way in which the quantity of particular product depends upon the quantities of a particular set of inputs used.

Samuelson<sup>17</sup> argued that a production function is one which would indicate the maximum amount of output capable of being produced by each and every set of specified inputs.

Forsund<sup>18</sup> *et al.* viewed the text book definition of a production function to give the maximum possible output which can be produced from given quantities of a set of inputs.

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<sup>15</sup>Handerson, J.M. and R.E. Quant, **Micro Economic Theory - A Mathematical Approach**, (Tokyo : McGraw Hill, Kogakusha Ltd., 1971), p.54.

<sup>16</sup>Bishop, C.E. and W.D. Toussiant, **Introduction to Agricultural Economic Analysis**, (Tokyo: Toppan Company Ltd., 1972), p.30.

<sup>17</sup>Samuelson, P.H., **Economics**, (Tokyo: McGraw Hill, Kogakusha Limited, 1973), pp. 64-65.

<sup>18</sup>Forsund, F.R., C.A.K. Lovell and Peter Schmidt, "A Survey of Frontier Production Functions and of their Relationship to Efficiency Measurement", **Journal of Econometrics**, 13: 5-15, 1980.

Ferguson<sup>19</sup> defined the production function as a schedule showing the maximum amount of output that can be produced from a specified set of inputs, given the existing technology or state of art. In short, production function is a catalogue of output possibilities.

Koutsoyiannis<sup>20</sup> defined production function as a purely technical relation which connects factor inputs and output relationship. It describes law of proportion i.e., the rate of transformation of factor inputs into product (output) at any particular time period. The production function includes all the technical efficiencies of production.

Battese<sup>21</sup> defined the production function in terms of the maximum output that can be produced from a specified set of inputs, given the existing technology available to the firms involved.

(In the present study, the production function was defined (Y) as a mathematical relationship between the yield of banana and the following inputs namely, area (x1), manures (x2), fertilizer Nitrogen (x3), Phosphorus (x4), Potash (x5) value of plant protection chemicals (x6), cost of irrigation (x7) and human labour (x8). In algebraic forms of the production function given as  $Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 / \mu_i)$ , where  $\mu_i$  indicate the fixed factors.)

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<sup>19</sup>Ferguson, C.E., **Micro Economic Theory**, (U.S.A. Home Wood Illinois, 1982), p.97.

<sup>20</sup>Koutsoyiannis, A., **Modern Micro Economics**, (Hongkong: The McMillan Ltd., London, 1983), pp.105-106.

(<sup>21</sup>Battese, G.E., "Frontier Production Function and Technical Efficiency - a Survey of Empirical Applications in Agricultural Economics", **Agricultural Economics**, 7: 185-208, 1992.)

## Resource Use Efficiency

Heady<sup>22</sup> defined resource use efficiency only in terms of a choice indicator. He used the price ratio as the efficiency measure by which decisions could be made. He set down the necessary condition for the use of variable resources to a fixed factor as equally of the factor product price ratio to the marginal productivity of the resource.

Khusro<sup>23</sup> measured the farm efficiency in terms of output per unit of single input or as output per unit cost of all inputs.]

According to Johl and Kapur<sup>24</sup> efficiency could be related to (i) the operation of farm business as a whole (ii) any individual phase as the business line of production or enterprise (iii) the use of variable factors of production or resource (land, labour or capital) (iv) to any single input (fertilizer, seed, machine etc.). The various farm efficiency measures could be discussed in terms of physical efficiency measures and variable efficiency measures. They could also be further categorised as ratio measures and absolute and aggregate measures.

Rajendran<sup>25</sup> employed net income per acre of chillies, returns

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<sup>22</sup>Heady, E.O., **Economics of Agricultural Production and Resource Use**, (New York: Engle wood Cliffs, M.J. Prentice Hall Inc. 1957), p.98]

<sup>23</sup>Khusro, A.M., "Returns to scale in Indian Agriculture", **Indian Journal of Agri. Economics**, 19 (3 & 4): 51-80, 1964.

<sup>24</sup>Johl, S.S. and T.R. Kapur, **Fundamentals of Farm Business Management**, (Delhi: Kalyani Publishers, 1981), p.315.

<sup>25</sup>Rajendran, G., "A study on the Economics of production and Resource use efficiency in chillies of Satur taluk, Ramanathapuram district". (Unpublished M.Sc Ag. thesis submitted to TNAU, Coimbatore, 1978).

to capital investment and labour earnings per employed mandays as measure of efficiency.

Bhat and Dhar<sup>26</sup> examined the resource-use efficiency in apple cultivation in Jammu and Kashmir state. The major objectives of the study were to determine the optimal resource allocation for cultivation of apple and to suggest means for increasing profitability of production without raising total costs. The Cobb-Douglas production function model was used for the analysis and issues focused on included the estimation of factor prices, returns to scale and marginal value products.

In the present study the individual input-use-efficiency was measured both in terms of physical efficiency (production elasticity/marginal products) and by computing the ratios of the value of marginal product to the price of respective inputs that significantly influence production.

### Technical Efficiency

Farrell<sup>27</sup> used the concept of efficient production frontier which was defined as the locus of minimum combination of inputs that could produce one unit of output given a level of technology. He also identified technical efficiency and allocative efficiency as the components of economic efficiency. He defined technical efficiency as the measure of a firm's success in producing maximum output from given inputs.

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<sup>26</sup>Bhat, G.M. and M.P. Dhar, "Resource Use Efficiency of Apple Cultivation in Jammu and Kashmir State", **Indian Journal of Economics**, 69(272) : 51-58, 1988)

<sup>27</sup>Farrell. M.J., "The measurement of Productive Efficiency". **Journal of Royal Statistical Society**, Ser (H), Part III, 10: 53-60, 1957.

Ferguson<sup>28</sup> defined the frontier production function as the relationship that describes the maximum possible output for the given combination of inputs.

Heady<sup>29</sup> defined the efficiency as the capacity or ability of any person, process or thing to realise the specified goal. Economic efficiency is said to be achieved when the resources are used in a manner to maximise the particular objective or end quantity which is relevant to the economic unit under consideration.

Schmidt and Lovell<sup>30</sup> explained technical inefficiency as the inability to produce the maximum (ie. frontier) output from given inputs and the allocative inefficiency as the inability to combine inputs in optimum proportions given the input price.

Broek<sup>31</sup> *et al.* indicated that the key question when defining the frontier function concept is whether to allow actual observations to the above frontier or not. The frontier is called deterministic if all the observations lie on or below the frontier and stochastic if observations can be above the frontier due to random events.

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<sup>28</sup>Ferguson, C.E., **Op. Cit.**, p.97.

<sup>29</sup>Heady, E.O., **Op. Cit.**, p.98.

<sup>30</sup>Schmidt, P. and C.A.K. Lovell, "Estimating Technical and Allocative Inefficiency Relative to Stochastic Production and Cost Frontier", **Journal of Econometrics** 9: 343-346, 1979.

<sup>31</sup>Broek, J.V.D., F.R., Forsund, Lennart, Hjalmarsson and Wim Meevsen, "On the Estimation of Deterministic and Stochastic Frontier Production Functions", **Journal of Econometrics**, 13: 117-138, 1980.

Ureta and Rieger<sup>32</sup> emphasised that the key feature of the stochastic production frontier is that the disturbance term is composed of two parts, a symmetric and a one-sided component. The symmetric component captures the random effects outside the control of the decision-maker including the statistical noise contained in every empirical relationship. The one-sided component captures deviations from the frontier due to inefficiency. They also indicated that the biggest advantage of the stochastic production frontier model is the introduction of a disturbance term representing the statistical noise comprising of measurement error and exogenous shocks beyond the control of the production unit in addition to the efficiency component. Hence, technical efficiency measures obtained from stochastic frontier are expected to be superior than those obtained from deterministic models.

Battese and Tassema<sup>33</sup> defined technical efficiency of a given farm as the factor by which the level of production for the firm is less than its frontier output.

Jayaram<sup>34</sup> *et al.* defined technical efficiency as the maximum possible yield available with a given level of input use.

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<sup>32</sup>Ureta, B.E. and L. Riegr, "Alternative Production Frontier Methodologies and Dairy Farm Efficiency", **Journal of Agricultural Economics**, 41(2): 218-219, 1990.

<sup>33</sup>Battese, G.E. and G.A. Tessema, "Estimation of Stochastic Frontier Production Function with Time Varying Parameters and Technical Efficiencies using Pad Data from Indian Villages, **Agricultural Economics**, 9:314, 1992.

<sup>34</sup>Jayaram, H., G.S. Chandrasekar and Lalith Achoth, "An Economic Analysis of Technical Efficiency in Rice cultivation in Mandya : Some Issues in Resource Pricing", **Indian Journal of Agricultural Economics**, 47(4) : 677-682, 1992.

According to Shanmugam and Palanisami<sup>35</sup> the measurement of economic efficiency includes technical efficiency and price efficiency. Technical efficiency refers to the proper choice of production function among all those activities in use by farms. Price efficiency refers to the proper choice of input combinations. The issue of economic efficiency in agriculture has now been broadened from the earlier emphasis on price efficiency to consider technical efficiency also.

Kumbhakar<sup>36</sup> defined the production frontier as the locus of maximum possible outputs for each level of input use. A producer is said to be technically efficient if the observed output was maximum, given the input quantities and a failure on the part of the farm to produce the frontier level of output is attributed to technical inefficiency.

Bastine<sup>37</sup> examined the comparative economic efficiency of different categories of irrigated farms pertaining to coconut and arecanut using corrected ordinary least squares method by first estimating a Cobb-Douglas production function and then correcting the constant term by a

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<sup>35</sup>Shanmugam, T.R. and K. Palanisami, "Measurement of Economic Efficiency - Frontier Function Approach", **Journal of the Indian Society of Agricultural Statistics**, 45(2) : 125-242, 1993.

<sup>36</sup>Kumbhakar, B.C., "Efficiency Estimation in a Profit Maximising Model Using Flexible Production Function", **Agricultural Economics**, 10(2) : 143, 1994.

<sup>37</sup>Bastine, L.C., "Irrigation Investments in Small Holder Plantation Crops of Kerala - An Economic Appraisal" (Unpublished Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore, 1994).

correction factor worked out from the moments of the residuals. The variables used were labour in man days, fertilizer cost in rupees, manure cost in rupees and irrigation measured in M<sup>3</sup> per annum.

Heshmati and Kumbhakar<sup>38</sup> dealt with the estimation of technical efficiency using pseudo-panel data constructed from rotating panel data on Swedish crop farms where each unit was observed for a maximum of four years. Farms were grouped into 89 cohorts, using their common time-invariant characteristics and the cohorts were used as individual units in the empirical analysis. The overall technical inefficiency was decomposed into a persistent and a residual component. An alternative model with time varying technical inefficiency was also considered. In addition to technical inefficiency, measures of returns to scale and technical change were also obtained.

In the present study the mean technical efficiency was measured by estimating a stochastic frontier function using the maximum likelihood method. The same set of dependent and independent variables used to estimate the production function were retained in the instant case also.

## Review of past studies

### Studies on Impact Analysis

The study of Tewari and Sharma<sup>39</sup> revealed that the project

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<sup>38</sup>Heshmati A. and S.C. Kumbhakar, "Estimation of Technical Efficiency in Swedish Crop Farms : A Pseudo Panel Data Approach", **Journal of Agricultural Economics**, 48(1) : 22-37, 1997.

<sup>39</sup>Tewari, S.C. and R.K. Sharma, **Op. Cit.**, 53-60.

Review of past studies R  
The study of Tewari & Sharma revealed 23  
Project

area farms which had adopted the new technology package were found to have a gross income nearly 54% higher than those farms in the non-project area. Farmers of the project areas spent 5% more on inputs as compared to those in the non-project areas and the size of the coefficients for manure and fertilizer were higher on project area farms compared to non-project area farms.)

The study of Sharma<sup>40</sup> *et al.* demonstrated that with a moderate increase in the use of inputs coupled with the latest techniques of carrying out agricultural operations, such as line sowing, a significant increase in productivity could be obtained. The study also indicated substantial scope for increasing the use of fertilizers to augment agricultural production and to achieve optimum resource use efficiency on marginal farms. The study further revealed that emphasis should be laid on the prompt transfer of latest farm technologies available in agricultural universities and research institutes to the farmers through extension agencies.

The study by Lata<sup>41</sup> *et al.* showed that with moderate increase in the use of inputs coupled with new techniques of carrying out agricultural operations, a significant increase in productivity could be obtained and maintained after the withdrawal of the Lab to Land Programme.

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<sup>40</sup>Sharma, H.R., S.K. Sharma and R.C. Bhardwaj, **Op. Cit.**, 547-550.

<sup>41</sup>Lata, S., Y. Agnihotri and S.P. Mittal, **Op. Cit.**, 695-699.

The production function analysis made by Mattigatti<sup>42</sup> *et al.* to analyse the impact of operation flood using ordinary least squares for the data sets obtained from members and non-members of cooperatives indicated that the introduction of cooperatives increase in herd size and the cross breeding of cows could increase resource use efficiency in production of cow milk.

### **Studies on production functions and resource use**

Muraleedharan<sup>43</sup> examined the resource use efficiency in rice cultivation on kole lands in the context of new technological change. 142 cultivators in Trichur District were selected for the study and data were collected for the year 1978/79. A Cobb-Douglas production function was fitted to the data to study the resource use efficiency by comparing the estimated marginal value product of various inputs with their respective factor costs. It appeared that the rice cultivators could not allocate their inputs efficiently and there seemed to be considerable scope for augmenting profit from cultivation on the kole lands by optimum use of inputs.

Misra<sup>44</sup> analysed data from two tea-producing regions of West Bengal in 1989, to examine resource use efficiency. Econometric

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<sup>42</sup>Mattigatti, R., H.G.S. Murthy, G.K. Hiremath and S. Mallikarjunappa, *Op. Cit.*, 145-153.

<sup>43</sup>Muraleedharan, P.K., "Resource Use Efficiency in Kolelands in Trichur District - Kerala", *Indian Journal of Agricultural Economics*, 42(4) : 578-586, 1987.

<sup>44</sup>Misra, S.R., "Resource Use Efficiency in Tea Plantations, *Agricultural Situation in India*, 46(11) : 807-810, 1992.

testing of a Cobb-Douglas production model, expressing the input-output relationship per hectare, suggested that the output was more responsive to a given input in larger farms. Inadequate working capital and lack of knowledge concerning innovations inhibited small farms ability to increase productivity. Further, a low marginal value of product for labour indicated over-utilization of manpower on small farms. The study concluded that more efficient allocation of resources should be promoted through a well structured land rehabilitation programme specifically designed for small farmers.

Mirotchie and Taylor<sup>45</sup> used a translog production function for analysing cereal production in state farms in Ethiopia between 1980 and 1985. The farms were found to be operating at constant returns to scale. Manual labour was under utilized, while machinery and other modern inputs were over-utilized. Elasticities of substitution between labour and these over-utilized inputs were low.

Rana<sup>46</sup> *et al.* analysed the economics of seed-potato cultivation in the two districts of Himachal Pradesh by computing the costs and returns and estimating the resource-use efficiency. The findings showed that the farmers in Lahaul-Spiti district reaped higher benefits by using more material inputs than those in Shimla district. However, the

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<sup>45</sup>Mirotchie and D.B. Taylor, "Resource Allocation and Productivity of Cereal State Farms in Ethiopia", *Agricultural Economics*, 8(3) : 187-197, 1993.

<sup>46</sup>Rana, R.K., S.C. Tiwari and K.K. Raina, "Resource Use Efficiency in Seed Potato Production", *Economic Affairs*, 38(3) : 168-172, 1993.

production function estimates and the study of the ratios of the marginal value product to factor cost indicated that resource use in both zones was below the optimum level.

Singh<sup>47</sup> *et al.* used Cobb-Douglas production function for a sample of 330 sugarcane growers from six districts in Western Uttar Pradesh, to estimate the production elasticities of inputs used in sugarcane cultivation. Data were collected for 1988/89 and 1989/90 and were analysed separately for four size groups of farms (small, medium, large and average). The regression coefficient estimates indicated that increase in use of inputs in all the farms belonging to different size group with the exception of expenditure on plant protection on medium and large farms) would significantly increase production and income.

Velayudham and Zeaudeen<sup>48</sup> investigated the costs and returns of sesame production and evaluated the resource use efficiency in sesame production in South Arcot district of Tamil Nadu. The efficiency of input use was studied and 87% of the variation in yield was explained by the five independent variables included in the model (land, seed, manure, human labour and bullock power. Land and human labour were found to influence the production of sesame positively and significantly.

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<sup>47</sup>Singh, K.V., S. Kumar and R.N. Malik, "Resource Use Efficiency of Sugarcane Farms (A Micro level Study of Western Uttarpradesh)", *Cooperative Sugar*, 25(1/2) : 43-45, 1993.

<sup>48</sup>Velayudham, K. and P. Zeaudeen, "Resource Use Efficiency in Sesame Production", *Agricultural Situation in India*, 48(9) : 661-664, 1993.

Sharma and Moorti<sup>49</sup> examined the resource use efficiency, factor demand and product supply elasticities in tea farming in Kangra and Mandi districts of Himachal Pradesh, using data collected from a sample of 180 farmers. The existing input use of the tea farms was found to be higher than the optimum input use, which implied the scope for rationalising the input use to produce the current level of output. Allocative efficiency analysis showed under utilization of modern inputs (fertilizers and chemicals) and over-utilization of land in tea plantations. The positive cross elasticities of demand for different inputs showed that they were substitutes.

Tiwari and Dheer<sup>50</sup> estimated the resource use efficiency of sugarcane ratoon cultivation and the marginal value productivity of various factors of production. Data were collected from a sample of 40 farmers in Gobind Pitaunjhia village in Runi Saidpur community development block in North Bihar. The sum of estimated parameters of the Cobb-Douglas production function which was less than one for all inputs, indicated diminishing returns. The highest Marginal Value Product per rupee invested was recorded for human labour followed by manures and fertilizers.

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<sup>49</sup>Sharma, R. and V. Moorti, "Resource Use Productivity in Tea Farming in Himachal Pradesh : A Regional Study", **Indian Journal of Regional Science**, 26(1) : 87-93, 1994.

<sup>50</sup>Tiwari, R. and D.P. Dheer, "Resource Use Efficiency of Ratoon : Sugarcane Farms in North Bihar", **Indian Sugar**, 44(2) : 109-111, 1994.

Reddy<sup>51</sup> reported the nature and significance of technology in the different sizes of farm holdings raising paddy crop, by studying the resource use efficiency of various input factors for Cuddapah district in Andhra Pradesh. The results indicated the need for rationalisation of resource use in all sizes of farm. In the case of small farms particularly, the results indicated that the application of HYV seeds, irrigation and chemical fertilizers and pesticides should be reduced, whereas the use of bullock-power and human labour should be increased in order to increase yields. In the case of medium farms the results showed that the paddy yield could be increased by greater application of HYV seeds, irrigation, chemical fertilizers and pesticides, and by reducing the use of bullock power and human labour. In the case of large farms the analysis revealed that the application of HYV seeds, irrigation and chemical fertilizers and pesticides should be increased in order to produce greater yields.

Tripathi<sup>52</sup> studied the economics of rapeseed cultivation based on data collected in 1988/89 from a sample of 140 farmers in valley, mid-hill and high-hill areas in the Tehri Garhwal hills in Uttar Pradesh. The analysis of resource use efficiency indicated that crop output can be raised through increased use of fertilizers, manures and human labour, but by rationalising the use of seed in order to improve net returns.

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<sup>51</sup>Reddy, N.R.V., "Technological Parameters in Paddy Production Function : A Case Study of Cuddapah District of Andhra Pradesh", **Indian Journal of Economics**, 75(4) : 497-503, 1995.

<sup>52</sup>Tripathi, R.S., "Rapeseed Cultivation in Rainfed Hill Farming : A Case Study", **Indian Journal of Agricultural Research**, 29(1/2) : 10-14, 1995.

Ayanwale and Isijola<sup>53</sup> conducted a study in Osun State of Nigeria. Stratified sampling technique was used to select 50 farms each of small and large size. Production functions were fitted to each category of farm sizes to determine the level of economic efficiency of resource use. The marginal value productivity approach was used to estimate the efficiency of resource use when compared with their respective factor cost. Results obtained showed that in maize, seeds, insecticides and fertilizer were underutilised on small farms, but, these resources were overused on large sized farms. However, both the categories of farms needed to expand their existing area of cultivable land to exploit the potential for increased farm income.

#### Studies on Efficiency Measures:

Ali and Chaudhry<sup>54</sup> analysed agricultural production efficiency in four irrigated cropping regions of the punjab province of Pakistan by comparing on the basis of a probabilistic frontier production function estimated from whole-farm survey data for the year 1984-85. It was found that the gross income of farmers could be increased by 13% at the current levels of resource use if the production gap between 'best practice' and 'average' farmers could be suitably narrowed in all cropping regions. This would increase profits by up to 40 per cent. No significant

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<sup>53</sup>Ayanwale, A.B. and C.O. Isijola, "Farm Size and Economic Efficiency : The Case of Some Selected Farms in Osun State of Nigeria", **Indian Journal of Economics**, 67 (307) : 551-566, 1997.

<sup>54</sup>Ali, M. and M.A. Chaudhry, "Inter-regional Farm Efficiency in Pakistan's Punjab : a Frontier Production Function Study", **Journal of Agricultural Economics**, 41(1) : 62-74, 1990.

difference in technical efficiency was found across the regions. Economic efficiency was similar across all cropping regions except in the cotton region, which had significantly lower economic efficiency due to higher allocative inefficiency.)

Jayaram<sup>55</sup> *et al.* analysed the technical efficiency among the rice growing farmers in Mandya district of Karnataka using the frontier production function with a sample of 100 farmers. The study revealed the existence of glaring over use of resources in the production of rice. The input use was found to be highly inefficient. The efficiency indices derived using the Kopp measure of technical efficiency indicated the degree of inefficiency in the use of selected factors in the production of rice. The large farmers was found to be more efficient than the small farmers. The highly inefficient use of resources particularly in the case of small farmers suggested improper pricing of resources, such as, fertiliser and irrigation, leading to wastage.

Tran Vo Hung Son<sup>56</sup> *et al.* analysed the technical efficiency of natural rubber production by state farms in Vietnam. A time-varying stochastic frontier production function model for unbalanced data was estimated for 33 farms. Individual farm technical efficiencies were reported and discussed. One of the main results concerned the bi-modal distribution of technical efficiency indices. A few farms operated near the production frontier while the bulk operated well below the frontier.

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<sup>55</sup>Jayaram, H., G.S. Chandrasekar and Lalith Achoth, **Op. Cit.**, 678-682

<sup>56</sup>Tran Vo Hung Son, Tim Coelli and Euan Fleming, "Analysis of Technical Efficiency of State Rubber Farms in Vietnam", **Agricultural Economics**, 9(3) : 183-201, 1993.

Battese<sup>57</sup> *et al.* used a single stage model for estimating technical inefficiencies of production in a stochastic frontier production function in the analysis of panel data for wheat farmers in selected districts of Pakistan. The technical inefficiency effects were highly significant, implying that the traditional production function model was inadequate for the analysis of wheat production of the four districts involved. The results showed that in the district of Faisalabad, the technical inefficiencies of production tended to be smaller for older farmers and those with greater formal schooling. In addition, the levels of wheat production for farmers in Faisalabad tended to approach their potential frontier production levels over time, although there was no evidence of technical change. The technical efficiencies of the wheat farmers showed considerable variation over time within each district, such that the mean technical efficiencies ranged from 57 per cent to 79 per cent in the four districts.

Panda<sup>58</sup> examined the efficiency and productivity of sericulture farms in Tamil Nadu using a frontier production function derived from Cobb-Douglas production function and estimated by corrected ordinary least squares (COLS) method. Timmer's measure of technical efficiency and Kopp's measure of allocative efficiency of various resources utilised in Sericulture farms were examined. The functional

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<sup>57</sup>Battese, G.E., Sohail.J. Malik and Manzoor A. Gill, "An Investigation of Technical Inefficiencies of Production of Wheat Farmers in Four Districts of Pakistan", *Journal of Agricultural Economics*, 47(1) : 37-49, 1996.

<sup>58</sup>Panda, R.C., "Efficiency and Productivity - The Case of Sericulture Farms in Tamil Nadu" *Indian Journal of Agricultural Economics*, 51(3) : 355-364, 1996.

analysis revealed the scope for increasing Cocoon production through increased use of disease free layings, better silk worm germplasm and efficient use of labour. The farm specific technical efficiency and input specific allocative efficiency exhibited scope for minimising inefficiency in Sericulture units, both in traditional and non-traditional areas.

Tadesse and Krishnamoorthy<sup>59</sup> examined the level of technical efficiency across ecological zones and farm size groups in paddy farms of Tamil Nadu. The study showed that 90% of the variation in output among paddy (IR-20) farms in the state was due to differences in technical efficiency. Land, animal power and fertilisers had significant influence on the level of paddy production. Varying from 0.59 to 0.97, the mean technical efficiency was found to be 0.83. The use of F-test in two-way analysis of variance (ANOVA) and censored regression (Tobit model) with dummies for ecological zones, farm size groups and their interactions had shown that, at mean level, the level of technical efficiency among paddy farms of the state differed significantly across agro-ecological zones and size groups as well.

Paul Wilson<sup>60</sup> *et al.* measured the technical efficiency in UK for potato crop through the estimation of a stochastic frontier production

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<sup>59</sup>Tadesse B. and S. Krishnamoorthy, "Technical Efficiency in Paddy Farms of Tamil Nadu : An Analysis Based on Farm Size and Ecological Zone", **Agricultural Economics**, 16(3) : 185-192.

<sup>60</sup>Paul Wilson, Dave Hadley, Stephen Ramsden and Ioannis Kaltas, "Measuring and Explaining Technical Efficiency in UK Potato Production", **Journal of Agricultural Economics**, 49(3) : 294-305, 1998.

function using cross sectional set of data for the 1992 crop year. Variation in the technical efficiency index across production units were explained through a number of managerial and farm characteristic variables. The technical efficiency index across production units ranged from 33 per cent to 97 per cent. Irrigation to the potato crop and storage of potatoes after harvest were positively correlated with technical efficiency. Number of years of experience in growing of potatoes, small scale farming practice and chitting of seed potatoes were all negatively correlated with technical efficiency.

## Design of the study

## CHAPTER III

### DESIGN OF THE STUDY

The design of the study or methodology is an important component of research. To fulfil the various objectives of the study, a more appropriate methodology for the conduct of the study is inevitable, regarding sampling design, data collection, specification of the empirical model and tools of analysis. In this chapter the methodology adopted for the present study, including the selection of study area and respondents, type of respondents, collection of data and the different tools of analysis used are presented.

#### **Selection of the study Area**

(The Kerala Horticulture Development Programme (KHDP) which was started in 1993, initially covered three districts namely, Thiruvananthapuram, Kottayam and Ernakulam. Four other districts were added later under the project. The three districts covered under phase-I were considered for the impact assessment since the programme had been in operation for the past six years. Among the three districts, Ernakulam ranked first in area and production of banana (nendran). Therefore, the study was confined to Ernakulam district only.

#### **Sampling Design**

Ernakulam district was purposively selected owing to its share in area and production of banana (area 48.7 per cent and production 45.6 per cent) as compared to the other two districts included in the first phase of the programme implementation (Table-2). The KHDP is implemented in 30 Panchayats of the Ernakulam district through self help groups (SHG's).

**Table 2. Area and production of banana (nendran) in select districts of Kerala, 1995-96**

Sl.No.	Districts	Area (ha)	Share (per cent)	Production (tonnes)	Share (per cent)
1.	Ernakulam	2529	48.7	33438	45.6
2.	Thiruvananthapuram	1094	21.1	14130	19.3
3.	Kottayam	1565	30.2	25815	35.1
	Total	5188	100	73383	100

Source : Directorate of Economics and Statistics, Agricultural Statistics, Government of Kerala, Thiruvananthapuram, 1997

Out of the 30 Panchayats, 17 are banana Panchayats and the rest are vegetable Panchayats. Out of the 17 panchayats where banana is the major crop under the programme (Table-3), the following six Panchayats were randomly selected. (i) Chengamanad (ii) Kalady (iii) Karumallur (iv) Kunnukara (v) Mudakuzha (vi) Nedumbassery. The study Panchayats are marked in Fig 1.)

To facilitate the assessment of the impact of the programme, two sets of sample farmers, one consisting of the beneficiaries and the other consisting of the non-beneficiaries were selected. In the present study a beneficiary farmer is reckoned as one who is a member of KHDP, enjoying the benefits of KHDP, having cultivated banana for at least three years including 1997-98 (the year for which the survey was conducted) since 1993-94. Similarly a non-beneficiary farmer is one who is not covered under the project, but cultivating banana (nendran) in the similar agro-climatic conditions.

From each of the six panchayats selected, fifteen beneficiary farmers and five non-beneficiary farmers were chosen randomly. Thus, the sampling framework covered 90 beneficiary farmers and 30 non-beneficiary farmers.

### Period of study

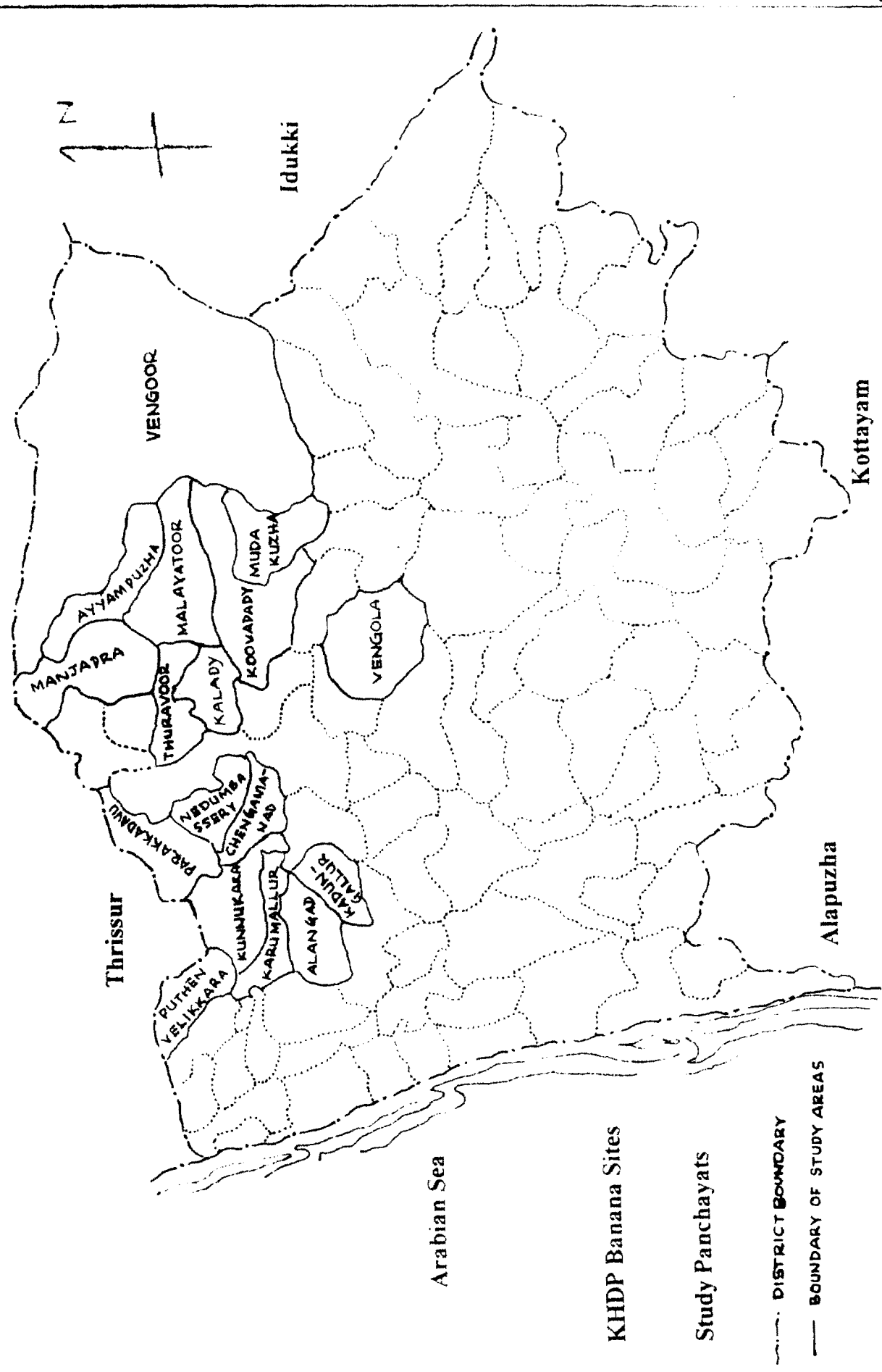
The agricultural year 1997-98 was fixed as the reference year for the study and the collection of data from the sample respondents were taken up during the months of January- February 1999.

**Table 3. Details of panchayats covered under Kerala Horticulture Development Programme in Ernakulam district**

Sl.No.	KHDP Banana sites	Other sites
1.	Alangad	Chendamangalam
2.	Ayyampuzha	Elanji
3.	Chengamanad	Kizhakambalam
4.	Kadungallur	Kuthattukulam
5.	Kalady	Maneed
6.	Karumallur	Mazhuvannoor
7.	Koovapady	Mulanthuruthy
8.	Kunnukara	Pampakuda
9.	Malayatoor	Payipra
10.	Manjapra	Piravam
11.	Mudakuzha	Puthencruz
12.	Nedumbassery	Thirumarady
13.	Parakkadavu	Thiruvaniyoor
14.	Puthenvelikkara	
15.	Thuravoor	
16.	Vengola	
17.	Vengoor	

Source : Kerala Horticulture Development Programme, Govt. of Kerala, Ernakulam

Fig 1. ERNAKULAM DISTRICT MAP(Showing study Panchayats)



Arabian Sea

KHDP Banana Sites

Study Panchayats

- DISTRICT BOUNDARY
- BOUNDARY OF STUDY AREAS

Thrissur

VENGLOOR

Idukki

Alapuzha

Kottayam

## The Data

R<sub>e</sub>

A pilot survey was conducted initially, to test the interview schedule and the pretested interview schedule was used for the collection of required data relating to basic details of the farm, farm family, cropping pattern, infrastructure, cost and returns of banana cultivation including input use and yield, credit availed, marketing of the produce etc., from the respondents after making necessary modifications. Although the respondents were not in the habit of keeping cultivation accounts attempts were made by cross verification with the members of the farm family and KHDP officials to minimise the recall bias.

The secondary data consisting of cropping pattern, land use pattern, land holding pattern, socio-economic factors were collected from the Department of Economics and Statistics, Ernakulam and also from the Directorate of Economics and Statistics, Thiruvananthapuram. The data on Climatological parameters were collected from the Meteorological Department, Thiruvananthapuram.

### Analysis of variance

The sample farmers were post stratified into two size groups. The farmers having 0.7 hectares and less were classified as group one and the farmers having more than 0.7 hectares were classified as size group two. A two way analysis of variance was conducted to see whether there was any significant difference in yield between Panchayats or between size groups. The results are presented in appendix I & II. The results indicated that there was no significant difference in yield either between the Panchayat or between size groups. Therefore, the samples were pooled and the analysis were taken up.

## **Tools of analysis**

The following tools of analysis were used to obtain the results.

### **(i) Conventional analysis**

Simple percentages, averages and frequency distribution were worked out to interpret the data related to agro climatic conditions, land utilization pattern, cropping pattern and also to understand the characteristic features of the sample farms, input use, yield, credit availed, marketing cost, farm income, etc.

### **(ii) Functional Analysis :**

In the present study the production function approach was used to identify and evaluate the factors influencing the banana cultivation in the case of both beneficiary and non beneficiary farmers. In the production process, the average product is a simple measure of relationship between the output and input. But, to know the efficiency of the resources used in a farm, it is necessary to know the marginal product rather than the average product.

The production function that examines the relationship between the output and all inputs together in agriculture has the following important objectives: (i) to estimate the production elasticities and marginal physical products to derive marginal returns to individual inputs, to study the efficiency of resources used and (2) to study the returns to scale.

The estimated values of regression coefficients were tested for statistical significance with the help of "t" test. The validity of the equation was tested by computing the "F" statistic. All the tests were conducted at five per cent and one per cent level of significance.

After examining the scatter diagram, the Cobb-Douglas type of production function was found to be the most appropriate form to explain the relationship between variable inputs and the yield. The production function is specified below.

### **Cobb-Douglas production function**

$$Y = a x_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} x_5^{b_5} x_6^{b_6} x_7^{b_7} x_8^{b_8}$$

where, Y	-	Banana (nendran) yield in kilograms
X <sub>1</sub>	-	Banana (nendran) area in hectares
X <sub>2</sub>	-	Manure in Kilograms
X <sub>3</sub>	-	Nitrogen in Kilograms
X <sub>4</sub>	-	Phosphorus in Kilograms
X <sub>5</sub>	-	Potassium in Kilograms
X <sub>6</sub>	-	Cost of Irrigation in rupees
X <sub>7</sub>	-	Cost of Plant protection chemicals in rupees
X <sub>8</sub>	-	Labour in mandays
a, b <sub>1</sub> -b <sub>8</sub>	-	Parameters to be estimated

### **(iii) Technical Efficiency**

To assess the technical efficiency the stochastic frontier was used.

#### **Frontier production function**

The Frontier production function was employed to measure the technical efficiency of the beneficiary and non-beneficiary banana farmers of the study area. The concept of production frontier is the same as that of production function. The production frontier is defined as the function that describes the greatest possible output from a given combination of inputs, that is, it is a production "frontier". Therefore, failure to operate on the production frontier is technical inefficiency.

The measurement of inefficiency is the main motivation for the study of frontiers. Farrell<sup>61</sup> elaborated the concept of technical efficiency. It involves the firm's ability to obtain the maximum output from a given set of inputs or resources. If a firm uses the best practice or method and could achieve the maximum output with a given set of inputs and technology, then, it is likely to be superior to another firm which does not get the same output with a given bundle of similar inputs and technology.

The estimation of production frontier proceeded along two general paths.

1. Deterministic frontier - which forces all observations to be on or below the production frontier so that all deviations from the frontier are attributed to inefficiency.

2. Stochastic frontier - where the disturbance term consists of two components, one component representing technical inefficiency and the other representing the usual random noise. The advantage of the stochastic frontier over the deterministic frontier is that farm-specific efficiency and random error effect can be separated.

Thus, in the stochastic production frontier, the disturbance term is composed of two parts, one, symmetric and the other, one-sided. The symmetric component captures the random effects outside the control of the decision maker, including the statistical noise contained in every empirical

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<sup>61</sup>Farrell, M.J., "The Measurement of Productive Efficiency", **Journal of the Royal Statistical Society**, A120 : 253-281, 1957.

relationship (such as poor input performance, bad weather, input supply breakdown, etc.). The one-sided component captures deviations from the frontier due to inefficiency.

### The stochastic frontier

The following equation denotes the production frontier in the matrix form.

$$Q_i = Q(X_{ki}\beta)e^{E_i} \quad i = 1 \dots n, k = 1 \dots k$$

where,  $Q_i$  is the output of the  $i$ th farm,  $X_i$  is a vector of  $K$  inputs of the  $i$ th farm,  $\beta$  is the vector of parameters to be estimated and  $E_i$  is a farm-specific error term. The stochastic frontier is called a 'composed' model because the error term is composed of two independent elements, ie,

$$E_i = V_i - U_i, \quad i = 1 \dots n$$

The term  $V_i$  is the symmetric component and permits random variation in output due to factors like weather and plant disease, etc. It is assumed to be identically and independently distributed as  $v_i = N(0, \sigma^2_v)$ . A one-sided component ( $U_i > 0$ ) reflects technical efficiency relative to the stochastic frontier  $Q_i = Q(X_{ki}, \beta) e^{v_i}$ . Thus  $U_i = 0$  for any farm lying on the frontier, while  $U_i > 0$  for any farm lying below the frontier. Hence, expression ( $U_i$ ) represents the amount by which the frontier exceeds realised output. Assuming that  $U_i$  is identically and independently distributed as  $U_i = (0, \sigma^2_u)$ , that is, the distribution of  $U$  is half normal. Thus,  $U_i$  takes the value zero when the farm produces on its outer-bound production function (realising all the technical efficiency potential), and is less than zero when the farm produces below its outer-bound production function (not realising fully its technical efficiency potential). This might

happen due to a number of factors, such as risk aversion, self satisfaction, information problems, which may prevent the farm from achieving its full potential.

The Cobb-Douglas functional form was generally preferred in most published papers on technical efficiency because of its well known advantages. In principle, confining the analysis to this functional form can be somewhat restrictive. However, it is possible to estimate the stochastic frontier production function using the MLE method. Aigner<sup>62</sup> suggested that the maximum likelihood estimates (MLE) of the parameters of the model can be obtained in terms of parameterisation.

The Density function can be written as:

$$f(u_i) = \frac{1}{\sigma u \sqrt{1/2\pi}} \exp \left[ -1/2 \frac{u_i^2}{\sigma^2 u} \right] \quad \text{if } U_i > 0$$

$$= 0 \quad \text{otherwise}$$

It follows that :

$$\sigma^2 = V(E\sigma)^2 = \sigma^2 V + \sigma^2 U$$

Further defining

$\lambda = \sigma u / \sigma v$  (i.e.) ratio of one sided error term to symmetric error term.

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<sup>62</sup>Aigner, D.J., C.A.K. Lovell and P. Schmidt, "Formation and Estimation of Stochastic Frontier Production Function Models", **Journal of Econometrics**, 6 : 21-37, 1977.

One advantage of estimating the frontier function is that it is possible to find out whether the farmer's deviation of yield from the frontier yield is mainly because he/she did not use the best practice or technique or is due to external random factors. Thus, one can say whether the difference between the actual yield obtained and the frontier yield, if any, occurred accidentally or not.

$$\text{i.e. } \sigma^2 = \sigma^2u + \sigma^2v; \quad \text{and } \gamma = \frac{\sigma^2u}{\sigma^2v}$$

Where  $\gamma$  is an indicator of relative variability of  $u_i$  and  $v_i$  that differentiates the actual yield obtained from the frontier yield. There are two interesting points about  $\gamma$ .

i) When  $\sigma^2v$  is tending to zero, which implies that  $u_i$  is the predominant error, then the  $\gamma=1$ . This means that the farmer's yield difference from the maximum feasible yield is because he/she did not use the best practice or technique.

ii) When  $\sigma^2u$  is tending to zero, which implies that the symmetric error term  $v_i$  is the predominant error, then  $\gamma$  is tending to zero. This means that the farmer's yield difference from the frontier yield is mainly because of either statistical error or external factors not under his/her control. In

this study, the MLE method was used for estimation as was used by Aigner<sup>63</sup> *et al.*; Olsen and Schmidt<sup>64</sup>, Kutavla<sup>65</sup> and Arindam Banik<sup>66</sup>.

### Mean technical efficiency (MTE)

The average technical inefficiency, (i.e.), the mean of the distribution of the  $U_i$  could be easily calculated. In the half-normal case [ $U_i$  distributed as the absolute value of  $N(0, \sigma^2 u)$  variables], the mean technical inefficiency is  $\sigma u \sqrt{2/\pi}$  and technical efficiency is  $1 - \sigma u \sqrt{2/\pi}$ . The technical efficiency can be evaluated given one's estimate of  $\sigma u$ , as in Aigner<sup>67</sup> *et al.* or Schmidt and Lovell<sup>68</sup>.

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<sup>63</sup>Aigner, D.J., C.A.K. Lovell and P. Schmidt, *Op. Cit.*, P 21-37.

<sup>64</sup>Olsen, J.A., and P.L. Schmidt, "A Monte Carlo Study of Estimators of Stochastic Frontier Production Functions", *Journal of Economics*, 13(1) : 67-82, 1980.

<sup>65</sup>Kutavla, S.S., "Application of Frontier Technology to Wheat Crop grown on Reclaimed Soils". *Indian Journal of Agricultural Economics*, 48(2) : 226-236, 1993.

<sup>66</sup>Arindam Banik, "Technical Efficiency of Irrigated Farms in a Village of Bangladesh", *Indian Journal of Agricultural Economics*, 49(1) : 72, 1994.

<sup>67</sup>Aigner, D.J., C.A.K. Lovell and P. Schmidt, *Op. Cit.*, P 21-37.

<sup>68</sup>Schmidt, P. and C.A.K. Lovell, "Estimating Technical and Allocative Inefficiency Relative to Stochastic Production and Cost Frontiers", *Journal of Econometrics*, 9: 343-366, 1979.

### **Assumptions in estimating the stochastic frontier model**

In the present study, the following assumptions were made which underline the specification of a stochastic frontier.

i) The frontier is stochastic in nature, due to factors beyond human control and symmetrically distributed error term present in it is responsible to capture the effects of outside random shocks, observations and measurement error on the dependent variable and the other statistical noise.

ii) Variations in the technical efficiency of individual farms are due to factors completely under the control of farmers.

The Cobb-Douglas production function used to study the input use efficiency was as such used to estimate the frontier production function models with the same set of independent variables affecting the banana yield for beneficiary and non-beneficiary farmers.

## **Description of the study area**

## CHAPTER - IV

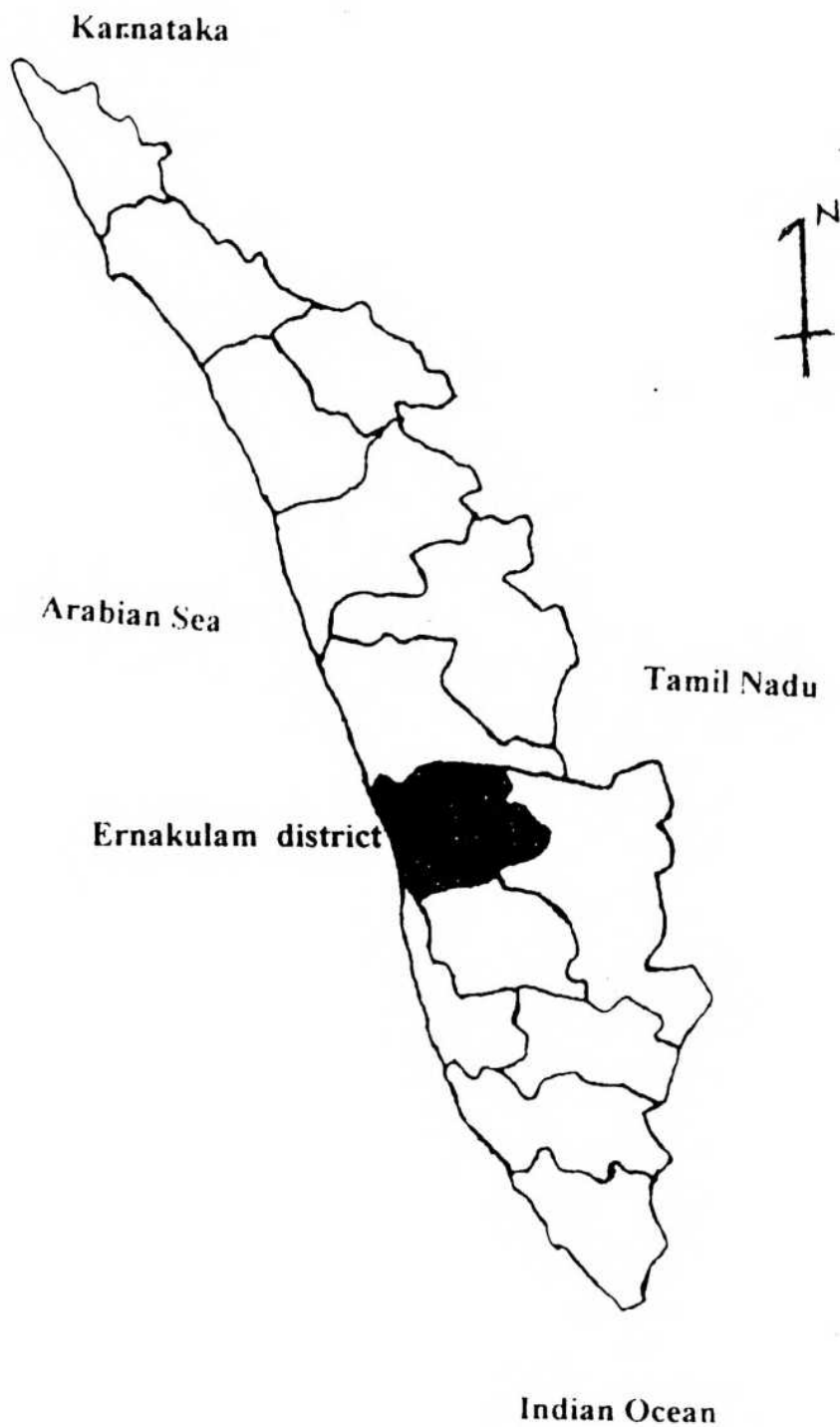
### DESCRIPTION OF THE STUDY AREA

A clear perception of the agro climatic and socio-economic characteristics of the study area will give a strong background to any social science research. Therefore, the various features such as geographical location, demographic features, soiltype, topography, rainfall, land use pattern, cropping pattern and infra-structure facilities pertaining to the study area are described below.

Kerala, the "God's own country" is known to the world for its stellar achievements in human resources development. The state which stretches over 580 Kms along the west cost of peninsular India is situated between 8°18' and 12°48' North latitude and between 74°52' and 77°-22' East longitude. The land is blessed with copious rainfall and fertile soil which is ideal for agriculture. The state has a geographical area of 38,863 sq.km which forms 1.18 per cent of the total geographical area of the Indian Union. It consists of 14 districts, out of which the Ernakulam district is chosen for the study (Fig.2).

In 1958, the Ernakulam district was formed by carving out different areas from Thrissur and Kottayam districts. The district comprises of the area of the erstwhile Travancore, Cochin and Malabar states. Cochin,

Fig 2. KERALA STATE MAP(Showing Ernakulam district)



Kanayanur, Paravur, Aluva, Kunnathunad, Muvattupuzha and Kothamangalam are the seven taluks of this district.

### **Location**

The district is bounded by the coastal belt of Arabian sea on the west, Kottayam and Alappuzha districts on the south, Idukki on the east and Thrissur on the north. The district lies between  $9^{\circ} 4'38''$  and  $10^{\circ}18'00''$  North latitude and  $76^{\circ} 1'00''$  and  $76^{\circ}46'00''$  East longitude.

### **Topography**

The district can be divided into 3 natural divisions on the basis of physiographic conditions such as the high land, the middle land and the low land. The low land division includes the entire Paravur and Cochin taluks and western part of Kanayanur taluk. The eastern portion of the Kanayanur taluk, Aluva, Muvattupuzha and Kothamangalam taluks come under the mid land region. The mid land region also includes major part of the Kunnathunad taluk and the remaining portion of this taluk is in the high land region. The distribution of area according to natural region is given in Table-4.

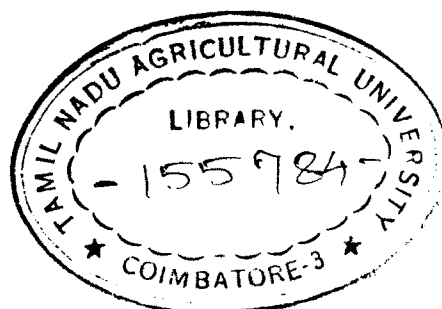
### **Climate and Rainfall**

A tropical humid climate with almost uniform temperature throughout the year is experienced in the district. The annual rainfall received per year is more than 3000mm which is closer to the normal

**Table 4. Distribution of area according to natural regions**

SL. No.	Taluks	Area in sq. km.			
		Low land	Mid land	High land	Total
1.	Aluva	-	326.29	-	326.29
2.	Paravur	191.63	-	-	191.63
3.	Cochin	140.86	-	-	140.86
4.	Kanayanur	295.01	77.71	-	372.72
5.	Kunnathunad	-	465.26	212.43	677.69
6.	Kothamangalam	-	284.94	-	284.94
7.	Muvattupuzha	-	433.52	-	433.52
	<b>Total</b>	<b>577.50</b>	<b>1487.72</b>	<b>212.43</b>	<b>2377.65</b>

Source : Directorate of Economics & Statistics, Panchayat Level Statistics-Ernakulam District, Govt. of Kerala, Thiruvananthapuram, 1996.



rainfall of 3051 mm received per year in the state. The monthwise rainfall received in the district is presented in Table-5. The major proportion of the rainfall is received in the months of June, July and August.

Heavy rains occurring continuously for 10-15 days during June, July and August result in flooding.

The maximum day temperature varies from 27°C to 34°C and the minimum temperature varies from 21°C to 28°C. The humidity is often very high, recording more than 90 per cent.

### **Soil**

Laterite soil, sandyloam soil and alluvial soil are the three major types of soils found in the district. Muvattupuzha, Kothamangalam, Kunnathunad and part of Aluva taluks have laterite soil, whereas, at Paravur, Cochi and Kanayanur taluks, the sandy loam soil is found. The alluvial soil is noticed in parts of Aluva and Kunnathunad taluks.

### **Rivers**

The most important rivers in the district are Periyar and Muvattupuzha. The Periyar is the longest river in the district, stretched over a length of 229 Kms. The river plays a prominent role in the development of the Agricultural, Industrial and Commercial sectors of the district. Another important river of the district is Muvattupuzha, which is formed by

**Table 5. Average monthly rainfall in Ernakulam district over years**

(millimetres)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1989	3	0	91	92	271	696	539	328	356	398	115	5	2844
1990	3	0	5	57	560	413	679	167	75	303	205	0	2467
1991	0	0	31	80	126	1321	649	566	28	401	122	4	3328
1992	0	1	0	36	308	826	891	495	363	326	279	6	3531
1993	0	32.8	18.0	75.9	216.5	837.1	908.1	262.4	115.5	487.6	103.5	49.4	3106
1994	98.3	7.4	12.0	174.2	196.6	904.6	900.4	525.8	258	543.2	175	44.1	3839.6
1995	8.7	6.6	69.6	156.0	471.6	615.5	764.4	570.3	358.7	331.6	239.7	0	3592.7
1996	23.2	2.4	0.6	129.1	54.7	616.0	780.1	422.2	568.5	326.6	117.9	171.9	3211.2
1997	5.8	1.0	48.0	86.3	130.1	550.6	942.6	471.9	421.4	329	383.8	144.2	3513.1

Source : Meteorological Centre, Govt. of Kerala, Thiruvananthapuram.

the union of three rivers namely Kaliyar, Thodupuzhayar and Kothamangalayar.

### **Backwaters**

The district is blessed with an attractive net work of canals and stretches of backwaters such as Vembanad and Kodungallur kayals along the western and north eastern coasts of the district and many streams and rivulets empty themselves into these backwaters. The Vembanad kayal is a large spacious lake with a length of 8 kms and maximum breadth of 40 Kms extending to an area of 205 sq.Kms.

### **Population**

According to 1991 census, Ernakulam district supports a population of 28.17 lakhs, of which, 14.09 lakhs are males and 14.08 lakhs are females. The density of population is 1170 per square kilometre. The literacy rate is 92.3 per cent.

### **Occupation**

The occupational distribution of the population in the district (census 1991) is given in Table-6. Out of the total work force, 92.7 per cent are main workers and 7.3 per cent are marginal workers. Males constitute 77 per cent of the total number of workers and 23 per cent are females. The work participation rate in Ernakulam district is 33.4 per cent.

**Table 6. Occupational distribution of working population of Ernakulam district-1991**

Occupation	Number of persons
Cultivators	81257
Agricultural labourers	137948
Other workers	225492
Total main workers	873634 (92.7)
Marginal workers	68736 (7.3)
Total workers	942370
Work participation rate	33.44

Source : Directorate of Economics & Statistics, Panchayat Level Statistics-Ernakulam District, Govt. of Kerala, Thiruvananthapuram.

(Percentage to total workers are given in parentheses)

In the agricultural sector, cultivators and agricultural labourers constitute 31.0 per cent and 18.3 per cent of the main workers, respectively. Other occupations are manufacturing, processing, servicing and repairs in household industry, constituting 50.7 per cent.

### **Land Utilization Pattern**

The total geographical area of the district is 235319 hectares which is 6.06 per cent of the total area of the State. Land utilization pattern of the district for the year 1995-96 given in Table-7 could reveal that the area under forest constituted 3.45 per cent, land put to non-agricultural uses occupied 14.99 per cent and cultivable waste land accounted for 1.48 per cent of the total geographical area. The net area sown in the district is 180441 hectares which is 76.68 per cent of the total geographical area. The total cropped area is 227843 hectares, and the cropping intensity is computed at 126.27 per cent.

### **Land holding pattern**

Data on the size and number of holdings in Ernakulam district are given in Table-8.

It could be seen from the table that more than 83 per cent of the total number of holdings are owned by small holders having less than 0.5 hectare of agricultural land in the state. The small holders accounted for more than 88 per cent of the total cultivator households in the case of Ernakulam

Table 7. Land utilization pattern for the year (1995-96)

(Area in hectares)

Description	Kerala		Ernakulam	
	Area	Percentage	Area	Percentage
Total geographical area	3885497	100.00	235319	100.00
Forest	1081509	27.83	8123	3.45
Land put to non-agriculture	313131	8.06	35272	14.99
Barren and uncultivable land	43154	1.11	1956	0.83
Permanent pastural and other grazing land	1170	0.03	49	0.02
Land under tree crops	26852	0.69	848	0.36
Cultivable waste	74382	1.92	3489	1.48
Fallow other than current fallow	29143	0.75	2423	1.03
Current fallows	51314	1.32	2718	1.16
Net area sown	2264842	58.29	180441	76.68
Area sown more than once	802294		47402	
Total cropped area	3067136		227843	

Source : Farm Information Bureau, Farm Guide, Govt. of Kerala, Thiruvananthapuram, 1998

Table 8. Land holding pattern of Kerala state and Ernakulam district in the year 1990-91

Holding size (hectare)	No. of holdings '000's		Total area '000' hectare	
	Kerala	Ernakulam	Kerala	Ernakulam
Below 0.02	635.13 (11.72)	189.51 (17.56)	8.29 (0.46)	1.23 (1.04)
Between 0.02-0.5	3914.28 (72.23)	360.67 (70.74)	535.14 (29.7)	41.14 (34.7)
Between 0.5-1.0	466.6 (8.61)	31.5 (6.21)	336.04 (18.65)	24.24 (20.44)
Between 1.0-2.0	280.7 (5.18)	20.12 (3.9)	381.45 (21.17)	26.81 (22.61)
Between 2.0-4.0	97.5 (1.8)	6.7 (1.3)	253.7 (14.08)	17.16 (14.47)
Between 4.0-10	21.68 (0.40)	1.16 (0.23)	112.8 (6.26)	5.81 (4.9)
10 and above	3.25 (0.06)	0.9 (0.01)	174.42 (9.68)	2.18 (1.84)
Total	5419.2 (100)	509.86 (100)	1801.9 (100)	118.57 (100)

Source : Land Use Board, Land Resources of Kerala State, Govt. of Kerala, Thiruvananthapuram, 1995.

(Percentage to total number/area are given in parentheses)

district. The extent of area cultivated by these farmers are however, only 30.16 per cent and 35.74 per cent, respectively, at state and district level.

### **Cropping pattern**

The district has a variety of crop mix due to the varied agro-climatic conditions. It could be seen from Table-9 that the important crops are coconut, rice and rubber, occupying 27.43 per cent, 24.81 per cent and 24.24 per cent, respectively. In the case of fruit crops, banana occupied 2.51 per cent of the total cropped area followed by mango with 1.89 per cent. Banana (Nendran) occupied 1.1% of the total cropped area in the district. At state level, the major crops are coconut with 29.8 per cent, rice with 15.36 per cent and rubber with 14.64 per cent.

### **Area under irrigation**

Irrigation is the most important input that influences the yield of various crops. The data pertaining to the irrigated area under different crops in the district presented in Table-10 shows that the irrigated area under rice (64.97 per cent) is the maximum followed by coconut (28.3 per cent) and banana (1.96 per cent)

### **Financial institutions**

The different kinds of financial institutions functioning in Ernakulam district are given in Table-11.

**Table 9. Distribution of area under major crops (1995-96)**

(Area in hectares)

Sl.No.	Crops	Kerala	Ernakulam
1.	Rice	471150 (15.36)	56533 (24.81)
2.	Coconut	914370 (29.8)	62502 (27.43)
3.	Rubber	448988 (14.64)	55247 (24.24)
4.	Coffee	82348 (2.68)	274 (0.12)
5.	Spices & Condiments	360733 (11.76)	14621 (6.42)
6.	Mango	81874 (2.67)	4321 (1.89)
7.	Banana (Nendran)	26267 (0.857)	2529 (1.11)
8.	Other plantain	46594 (1.5)	3378 (1.4)
9.	Vegetables	17616 (0.57)	1196 (0.52)
10.	Tapioca	113601 (3.7)	4575 (2.0)
11.	Other crops	503595 (16.46)	22667 (10.06)
12.	Total cropped area	3067136 (100)	227843 (100)

Source : Farm Information Bureau, Farm Guide, Govt. of Kerala, Thiruvananthapuram. 1998  
(Percentage to total are given in parentheses)

**Table 10. Cropwise area irrigated in Ernakulam district (1995-96)**

Crops	Area under irrigation (hectare)
Paddy	41745 (64.97)
Tubers	10 (0.015)
Vegetables	435 (0.67)
Coconut	18194 (28.3)
Arecanut	888 (1.38)
Clove and nutmeg	818 (1.25)
Other spices and condiments	127 (0.19)
Banana (Nendran)	1261 (1.96)
Betelvine	44 (0.06)
Sugarcane	33 (0.05)
Others	701 (1.2)
Total	64256 (100)

Source : Farm Information Bureau, Farm Guide, Government of Kerala, Thiruvananthapuram, 1998.

(Percentage to total are given in parentheses)

**Table 11. Financial institutions operating in Ernakulam district**

Sl.No.	Particulars	Numbers	No. per lakh population
1.	Nationalised bank branches	269	9.6
2.	Other scheduled bank branches	174	6.2
3.	Cooperatives	181	6.4

Source : Directorate of Economics and Statistics, Panchayat Level Statistics-Ernakulam District, Government of Kerala, Thiruvananthapuram, 1995.

A perusal of the Table-11 could reveal that the credit needs of the district is more or less equally served by the three kinds of banking institutions functioning in the district.

### **Transport facilities**

The details of transport facilities available in the district are furnished in Table-12. It could be seen that the various parts of the district are well connected by the transport network.

One airport is located in Cochin. Another airport established at Nedumbassery near Alwaye is yet to be commissioned. The sea port at Ernakulam (Cochin) is an important port handling many kinds of cargo. Besides, there are inland waterways facilitating transport of people and cargo in the district.

**Table 12. Transport facilities available in Ernakulam district**

Sl.No.	Particulars	Length (in Kms)
1.	National highways	138.74
2.	State highways	188.6
3.	PWD roads	1741.3
4.	Panchayat roads	7021.5
5.	Railway station (Nos.)	24
6.	Airports (Nos.)	2
7.	Ports (Nos.)	1

Source : Directorate of Economics and Statistics, Panchayat Level Statistics-Ernakulam District, Government of Kerala, Thiruvananthapuram, 1995.

## Results & Discussion

## **CHAPTER - V**

### **RESULTS AND DISCUSSION**

The results obtained from the analysis of the data are discussed below in two sections. Section - I includes the general characteristics of the sample house holds and the Section -II titled Impact Analysis deals essentially with the results relating to the objectives of the study.

#### **SECTION - I**

##### **GENERAL CHARACTERISTICS OF THE SAMPLE FARMERS**

The general characteristics of the sample farmers include age, sex, farming experience, family details, educational status of the head of the households and the family members and the land holding pattern.

##### **A. Age of Heads of Households**

The results furnished in Table-13 would show that among the beneficiary farm households, 46.7 per cent of the heads of the household were in the age group of more than 45 years, 32.2 per cent were in the age group of 35-45 years and 21.1 per cent were in the age group of less than 35 years. Among the non-beneficiaries, however, the heads of households in the age group of 35-45 years constituted 50.0 per cent, followed by 26.7 per cent for the age group with more than 45 years and 23.3 per cent for the age group with less than 35 years.

**Table 13 . Age of heads of farming households in the study region**

(numbers)

Sl.No.	Age in years	Beneficiary	Non-beneficiary	Total
1.	< 35	19 (21.1)	7 (23.3)	26 (21.7)
2.	35-45	29 (32.2)	15 (50)	44 (36.7)
3.	> 45	42 (46.7)	8 (26.7)	50 (41.6)
	<b>Total</b>	90 (100)	30 (100)	120 (100)

(Percentage to total are given in parentheses)

For the combined sample, the results indicated that 41.6 per cent of the heads of households were above the age of 45 years, 36.7 per cent under the age category between 35 and 45 years and 21.7 per cent below the age of 35 years. It could be seen that in the study area, while most of the heads of households were over the age of 35 years (78.3 per cent), the young heads of households involved in farming in the age group of less than 35 years were also in considerable numbers (21.7 per cent).

#### **B. Sexwise classification of heads of sample house holds**

The results presented in Table-14 indicated that all the heads of households in the non-beneficiary category were male farmers, whereas in the case of beneficiary farmers the female heads of households constituted 2.2 per cent. For the pooled sample, only 1.7 per cent were female farmers and the rest 98.3 per cent were male farmers.

#### **C. Experience in farming**

The experience in farming of the heads of the households are presented in Table-15. The results showed that among the beneficiary farmers, 48.9 per cent consisted of the heads of households with farming experience between 10 and 25 years, followed by 25.6 per cent with experience between 25 and 40 years, 20.0 per cent with experience of less than 10 years and the heads of the households with farming experience of more than 40 years constituted a miniscule of 5.5 per cent. The pattern was different for the non-beneficiary category, where the heads of households having experience between 10 and 40 years constituted 83.3 per cent. The

**Table 14. Sexwise classification of heads of sample households**

(numbers)				
Sl.No.	Sex	Beneficiary	Non-beneficiary	Total
1.	Male	88 (97.8)	30 (100)	118 (98.3)
2.	Female	2 (2.2)	0 (0)	2 (1.7)
	Total	90 (100)	30 (100)	120 (100)

(Percentage to total are given in parentheses)

**Table 15. Experience in farming**

(numbers)				
Sl.No.	Experience in years	Beneficiary	Non beneficiary	Total
1.	< 10	18 (20)	3 (10)	21 (17.5)
2.	10-25	44 (48.9)	10 (33.3)	54 (45)
3.	25-40	23 (25.6)	15 (50)	38 (31.7)
4.	> 40	5 (5.5)	2 (6.7)	7 (5.8)
	Total	90 (100)	30 (100)	120 (100)

(Percentage to total are given in parentheses)

results revealed that the KHDP could attract relatively more number of farmers who are freshers to agricultural profession.

For the combined sample 45 per cent of the heads of households had an experience of 10-25 years in farming and 31.7 per cent and 17.5 per cent, had experience between 25-40 years and less than 10 years, respectively. The percentage of farmers with the experience of above 40 years were low at 5.8 per cent.

#### **D. Educational status of the heads of households**

The results presented in Table-16 would indicate that the literacy level of heads of households happened to be 100.0 per cent. The heads of households educated upto upper primary level constituted 54.4 per cent, 56.7 per cent and 55.0 per cent respectively, for beneficiary, non-beneficiary and the combined sample. This was closely followed by those educated upto high school level with 32.2 per cent, 26.7 per cent and 30.8 per cent respectively, for the above groups. The heads of house holds who were educated only upto primary level and upto higher secondary level in the category of non-beneficiary were minimum in the range of 3.3 per cent with primary education to 13.3 per cent educated up to higher secondary level. There were no heads of households educated above higher secondary level. The discussion would reveal that most of the heads of households (around 85 per cent) were educated either upto upper primary or upto high school.

**Table 16. Educational status of the heads of households**

(numbers)				
Sl.No.	Educational status	Beneficiary	Non-beneficiary	Total
1.	Illiterate	0	0	0
2.	Primary (upto 4th Std.)	9 (10)	1 (3.3)	10 (8.3)
3.	Upper primary (5th Std. to 7th Std.)	49 (54.4)	17 (56.7)	66 (55)
4.	High School (8th Std. to 10th Std.)	29 (32.2)	8 (26.7)	37 (30.8)
5.	Higher Secondary	3 (3.4)	4 (13.3)	7 (5.9)
	<b>Total</b>	<b>90 (100)</b>	<b>30 (100)</b>	<b>120 (100)</b>

(Percentage to total are given in parentheses)

### **E. Family Details**

The details on composition of adults and children and the gender composition of the sample households are presented in Table-17 and Table-18 respectively. An analysis of results presented in Table-17 could reveal that out of the total number of family members, 80.9 per cent were adults and 19.1 per cent were children. In the case of both beneficiary and non-beneficiary farm households the pattern was more or less the same.

The genderwise classification of the families presented in Table-18 revealed that 50.9 per cent were males and 49.1 per cent were females for the sample as a whole. The compositions were more or less similar for both the beneficiary and non-beneficiary groups of farm households.

Similarly, the results presented in Table-19 revealed that the literacy level of the farm families happened to be 100 per cent. The members educated upto high school level constituted 43.15, 56.86 and 46.01 per cent respectively, for beneficiary, non-beneficiary and the combined sample. For the above three groups, the members educated upto higher secondary level remained the same at 15 per cent. The members educated upto primary level were 23.51 per cent, 11.76 per cent and 21.06 per cent respectively, for the above groups. The members who had education at degree level constituted 7.24 per cent, 12.75 per cent and 8.40 per cent respectively for the same groups.

**Table 17. Family details of the sample farmers**

(numbers)

Sl.No.	Family details	Beneficiary	Non-beneficiary	Total
1.	Adults	316 (81.7)	80 (78.4)	396 (80.9)
2.	Children	71 (18.3)	22 (21.6)	93 (19.1)
	Total	387 (100)	102 (100)	489 (100)

(Percentage to total are given in parentheses)

**Table 18. Genderwise classification of sample farm families**

(numbers)

Sl.No.	Family details	Beneficiary	Non beneficiary	Total
1.	Male	196 (50.6)	53 (51.9)	249 (50.9)
2.	Female	191 (49.4)	49 (48.1)	240 (49.1)
	Total	387 (100)	102 (100)	489 (100)

(Percentage to total are given in parentheses)

**Table 19. Educational status of farm families**

(numbers)				
Sl.No.	Educational status	Beneficiary	Non-beneficiary	Total
1.	Illiterate	-	-	-
2.	Primary (upto 4th Std.)	41 (10.60)	3 (2.94)	44 (8.99)
3.	Upper primary (5th Std. to 7th Std.)	91 (23.51)	12 (11.76)	103 (21.06)
4.	High school (8th Std. to 10th Std.)	167 (43.15)	58 (56.86)	225 (46.01)
5.	Higher Secondary	60 (15.50)	16 (15.69)	76 (15.54)
6.	Degree	28 (7.24)	13 (12.75)	41 (8.40)
	<b>Total</b>	<b>387 (100)</b>	<b>102 (100)</b>	<b>489 (100)</b>

(Percentage to total are given in parentheses)

## **F. Land Holding Pattern**

The land holding pattern of the sample farms are analysed and the results are presented in Table-20. The results showed that 93.4% of the beneficiary farmers were small farmers with an area of one hectare and less. In the case of non-beneficiary farmers the small farmers constituted 86.7 per cent. The farmers having more than one hectare constituted only 6.6 per cent, 13.30 per cent and 8.3 per cent respectively, for beneficiaries, non-beneficiaries and for the pooled sample.

The average size of the holdings worked out to 0.6 hectare for the beneficiary group and 0.77 hectare for the non-beneficiary group. The average area for the pooled sample worked out to 0.65 hectare.

## **Section II**

### **IMPACT ANALYSIS**

#### **(A. Cropping Pattern**

The results of the analysis of the cropping pattern in the sample households during the year 1997-98 are presented in Table-21. The results revealed that banana occupied 38.6 per cent of the total cropped area for the beneficiary households followed by vegetables with 23.3 per cent, paddy with 21.74 per cent, coconut with 10.14 per cent with other crops constituting 6.22 per cent. In respect of non-beneficiary farmers, paddy was the predominant crop occupying 73.4 per cent of the area, followed by banana with 14.5 per cent and the other crops occupied 12.10 per cent of

Table 20. Land holding pattern of sample farms

(numbers)				
Sl.No.	Size of the land Holding (in hectares)	Beneficiary	Non beneficiary	Total
1.	< 0.5	41 (45.6)	0 (0)	41 (34.2)
2.	0.5-1	43 (47.8)	26 (86.7)	69 (57.5)
3.	> 1	6 (6.6)	4 (13.3)	10 (8.3)
4.	Total	90 (100)	30 (100)	120 (100)
5.	Average size of the holdings (ha)	0.603	0.77	0.65
6.	Average gross cropped area (ha)	0.754	0.873	0.783
7.	Cropping intensity (per cent)	124.63	113.42	121.29

(Percentage to total are given in parentheses)

**Table 21. Cropping pattern of the sample farms**

(Area in hectares)				
Sl.No.	Crops	Beneficiary	Non beneficiary	Total
1.	Banana	26.2 (38.6)	3.8 (14.5)	30 (31.9)
2.	Paddy	14.7 (21.74)	19.22 (73.4)	33.97 (36.1)
3.	Coconut	6.88 (10.14)	1.21 (4.62)	8.09 (8.6)
4.	Vegetables	15.8 (23.3)	-	15.8 (16.8)
5.	Rubber	2.61 (3.8)	1.4 (5.3)	4.01 (4.3)
6.	Others	1.62 (2.42)	0.57 (2.18)	2.19 (2.3)
	<b>Total Cropped Area</b>	<b>67.86 (100)</b>	<b>26.2 (100)</b>	<b>94.06 (100)</b>

(Percentage to total are given in parentheses)

the total cropped area. For the pooled sample the area occupied by paddy, banana, vegetables, coconut and other crops were 36.1 per cent, 31.1 per cent, 16.8 per cent, 8.6 per cent and 6.6 per cent, respectively.

The inference drawn from the above analysis is that the beneficiary farmers naturally had more area under banana and vegetables and consequently the area under paddy was relatively lower.

#### **B. Extent of adoption of production technologies**

The extent of adoption of recommended technologies by the sample cultivators was assessed by (i) computing the proportion of the sample farmers following the production technologies and management methods namely, spacing, green manure application, use of direct fertilizers, propping and periodicity of irrigation recommended under KHDP and (ii) computing the level of adoption of these technologies and management methods. The results are presented Table-22 and Table-23.]

It could be seen from table-22 that 81.1 per cent of the beneficiary farmers followed the recommended spacing of 2x2 meters as against 16.7 per cent in the case of non-beneficiaries. As regards the green manure application, while 95.5 per cent of the beneficiaries followed the practice, it was only 10.0 per cent for the non-beneficiaries. Among the beneficiaries, 80.0 per cent of the farmers applied direct fertilizers, 100.0 per cent of the farmers followed propping and 92.2 per cent followed the frequency of irrigation (made once in a week). However, for the non-beneficiaries, the

**Table 22. Extent of adoption of production technologies by sample farms on select variables**

(numbers)

Sl.No.	Recommendations	Beneficiary farmers	Non beneficiary farmers
1.	2x2 metre spacing	73 (81.1)	5 (16.7)
2.	Green manure application	86 (95.5)	3 (10.0)
3.	Application of only direct fertilizers	72 (80.0)	13 (43.3)
4.	Propping	90 (100.0)	25 (83.3)
5.	Irrigation (atleast once in a week)	83 (92.2)	23 (76.7)

(Percentage to total sample for each of the technologies are given in parentheses)

**Table 23. Use of important inputs by the sample farms**

Sl.No.	Name of Input	Recommend ed quantity per hectare	Actual use per hectare by			
			Beneficiaries		Non-beneficiaries	
			Avg. qty. used	% deviation	Avg. qty. used	% deviation
1.	Suckers (Nos.)	2500	2219.72	-11.2	1265.13	-49.4
2.	Farm yard manure (qtls)	250	204.87	-18.1	90.97	-63.6
3.	Fertilizers (Kgs)					
	N	475	481.04	+1.3	203.33	-57.2
	P	287	211.72	-26.2	134.66	-53.1
	K	750	669.01	-10.8	200.85	-73.2

proportion of farmers adopting these practices were only, 43.3 per cent, 83.3 per cent and 76.7 per cent, respectively.

A perusal of table-23 would reveal that for the beneficiaries, the deviation from the recommended quantity was only -11.2 per cent for suckers, -18.1 per cent for farm yard manure, +1.3 per cent for the nutrient 'N', -26.2 per cent for 'P', and -10.8 per cent for 'K'. However, the deviation in the quantity of the aforesaid inputs usage for non-beneficiaries were, -49.4 per cent, -63.6 per cent, -57.2 per cent, -53.1 per cent and -73.2 per cent, respectively.

It could be inferred from table-22 and table-23 that the number of beneficiary farmers adopting the recommended practices were uniformly higher and the deviations in the quantity of inputs used were much lower from the recommended level, as compared to the non-beneficiary farmers.

### **C. Extent of use of credit facilities**

Provision of timely credit is one of the major objectives under the programme. Credit is made available to the farmers under KHDP, by creating a revolving fund. The designated branches of the following four nationalised Banks namely, State Bank of India, Canara Bank, State Bank of Travancore and Union Bank of India take the responsibility of extending credit. The collective responsibility of the farmers in the Self Help Groups to repay the credit had made the programme to operate with relatively less difficulty. The results presented in Table-24 would show that all the beneficiaries availed the credit facilities from the commercial banks and the

Table 24. Credit availed by sample farms

(numbers)				
Sl.No.	Institution	Beneficiary	Non beneficiary	Total
1.	Banks	90 (100.0)	3 (10.0)	93 (77.5)
2.	Co-operatives	0	4 (13.3)	4 (3.3)
3.	None	0	23 (76.7)	23 (19.2)
4.	Total	90 (100.0)	30 (100)	120 (100)
5.	Average credit availed			
	i) Per farm(Rs.)	23668.8	3333.3	
	ii) Per hectare (Rs.)	39251.74	4329	

(Percentage to total are given in parentheses)

average credit availed by a farm family was Rs.23,668.80. The credit availed per hectare by the beneficiary farmers was computed at Rs.39,251.74. Among the non-beneficiaries, however, only 23.3 per cent of the sample households availed credit from both commercial banks and cooperatives. The quantum of credit availed by them was also lower at Rs.3333.30 per farm family and Rs.4,329 per hectare.

#### **D. Use of marketing facilities of Banana under KHDP**

Among the six panchayats selected for the study, only three panchayats viz., Kalady, Kunnukara and Nedumbassery have the marketing facility through two field centres established under the programme. The results presented in Table-25 could show that the marketing facilities available under the KHDP field centres were utilized only by 28.9 per cent of the sample farmers. Nearly 43 per cent of the beneficiaries sold their produce in markets located in nearby towns. It was also found that 8.9 per cent of beneficiaries used both the nearby markets and the field centres of the programme. The sample farmers who sold their produce through the traders at the farm gate and local shops accounted for 18.9 per cent. In the case of non-beneficiaries, 66.6 per cent of the sample cultivators sold their produce through traders, 26.7 per cent through nearby market centres and 6.7 per cent through local shops.

The benefits that could accrue to the KHDP respondents through the market centres were assessed by computing and comparing the cost of marketing and price realised by selling through different sources. The

Table 25. Marketing details of sample farms

(numbers)			
Sl.No.	Marketing particulars	Beneficiary	Non beneficiary
1.	KHDP Field Centre	26 (28.9)	-
2.	Market	39 (43.3)	8 (26.7)
3.	KHDP field centre & market	8 (8.9)	-
4.	Traders	14 (15.6)	20 (66.6)
5.	Local shops	3 (3.3)	2 (6.7)
	<b>Total</b>	90 (100)	30 (100)

(Percentage to total are given in parentheses)

Table 26. Marketing cost and price realised in marketing through different sources

(Rupees per quintal)							
Sl. No.	Source of marketing	Average cost of marketing				Total	Price realised
		Transportation	Commission	Fee	Others (Unloading)		
1.	KHDP field centre	15	50	-	-	65	1000
2.	Market	15	80	5	7.50	107.5	1000
3.	Traders	-	-	-	-	-	800
4.	Local shops	4.75	-	-	-	4.75	850

results are presented in Table-26. The results indicated that there was no marketing cost while selling through traders and it was minimum at Rs.4.75 per quintal of banana when sold through local shops. The prices realised were however considerably lower, thereby the farmers were incurring a loss of Rs.135.00 and Rs.90.00 per quintal respectively, after accounting for the differences in prices received and marketing cost incurred when sold through these sources as compared to that of the KHDP field centre. The prices realised in KHDP field centre and the nearby markets remained the same at Rs.1000.00 per quintal. But, the marketing cost was higher while selling in the market by Rs.42.50 per quintal. The analysis clearly indicated that the farmers could realise a net benefit of Rs.42.50 per quintal by selling through the KHDP centre as compared to the nearby market, Rs.135.00 per quintal and Rs.89.75 per quintal respectively, while selling through traders and local shops, after accounting for the differences in prices received and the marketing cost incurred.

#### **E. Income of the sample Households**

The impact of the KHDP was also assessed by comparing the income earned from different activities <sup>by</sup> the beneficiaries and non-beneficiaries. The on-farm income included the income from crops and live stock. The non-form income included income from non-agriculture activities. The results are presented in Table-27. An analysis of the results furnished in the table would show that the on farm income of Rs.45048.36 excluding income from live stock which was only minimum out of the total income of

Table 27. On farm and non-farm income of sample farmers

(Rupees)				
Sl.No.	Particulars	Beneficiary Avg. Income	Non-beneficiary Avg. income	Combined Avg. income
A.	<b>On-farm income</b>			
1.	Income from banana	34123.40	8152.77	27630.74
2.	Income from other crops	8738.29	3857.83	7518.18
	Sub - Total	42861.69	12010.60	35148.92
3.	Income from livestock	2186.66	1720.00	2070.00
4.	Total on-farm income (1 + 2 + 3)	45048.36 (62.5)	13730.6 (34.6)	37218.92 (58.1)
B.	<b>Non-farm income</b>	27074.33 (37.5)	25983.33 (65.4)	26801.58 (41.9)
C.	<b>Total income (A+B)</b>	72122.69 (100)	39713.93 (100)	64020.5 (100)

(Percentage to total are given in parentheses)

Rs.71122.69 constituted the major share (63.34 per cent) for the beneficiary farmers. In the crop income, the share of income from banana alone was 79.6 per cent. Whereas, in the case of non-beneficiaries, the non-farm income constituted the major share of 65.4 per cent to the total income of Rs.39713.93. Even in the crop income, banana constituted only 67.88 per cent. It may be indicated that the non-farm income for both the beneficiary and non-beneficiary farmers was more or less same, at Rs.27074.33 and Rs.25983.33, respectively. The difference in total income was on account of on-farm income and more specifically due to income from banana. The income from crops for the beneficiary farmers was 2.57 times higher than that of the non-beneficiary farmers.

Thus, the above analysis would clearly reveal the impact of the project in enhancing the income of the farmers.

#### **F. Resource use efficiency of beneficiary and non-beneficiary farmers**

##### **i. Inputs used and yield realised by beneficiary and non-beneficiary farmers :**

The results presented in Table-28 would reveal that the inputs used and yield realised by the non-beneficiary farmers were very low as compared to the beneficiary farmers. The total cost of cultivation, the yield realised and the value of the main product were, Rs.67230.1, 21935.28 kg and Rs.2,19,350.28 respectively, for the beneficiary farmers. For the non-beneficiary farmers, however, these values were only, Rs.38136.76, 10250.65 kg and Rs.1,02,500.65, respectively. The results of the

**Table 28. Inputs used and yield realised per hectare in banana cultivation by beneficiary and non-beneficiary farmers**

Sl. No.	Particulars	Beneficiary farmers		Non-beneficiary farmers	
		Average quantity	Value (Rs.)	Average quantity	Value (Rs.)
1.	Suckers (nos.)	2219.71	4439.42	1265.13	2530.26
2.	Manure (Kgs)	20486.77	17004.02	9096.65	7550.22
3.	Fertilizers (Kgs)				
	N	481.04	4425.57	203.3	1878.32
	P	211.73	2646.63	134.7	1683.75
	K	669.01	6021.1	200.9	1808.1
4.	Irrigation (Rs)	-	7069.43	-	4505.9
5.	Plant protection chemicals (Rs.)	-	1247.09	-	1580.41
6.	Labour (mandays)	203.14	24376.8	138.39	16606.8
	Total cost		67230.1		38136.76
7.	Yield (Kgs)	21935.28	219350.28	10250.65	102500.65

production function analysis was taken up and the results are discussed in the following section.

*R*

**ii. Resource use efficiency : Production Function Analysis**

To study the resource use efficiency in banana production by the beneficiary and non beneficiary farmers, production functions were estimated separately, for the beneficiary and non beneficiary farmers. The Cobb-Douglas form was found to be suitable based on the scatter diagram and the production elasticities were estimated accordingly. The technical efficiency was computed from the Stochastic production frontier estimated using the Maximum Likelihood Estimation method.

**a) Resource use efficiency using OLS method**

**(i) Beneficiary farmers**

The results of the production function analysis are given in Table-29.

The coefficient of multiple determination ( $R^2$ ) was 0.92, which would mean that 92 per cent of the variation in the dependent variable was explained by the explanatory variables included for the analysis. (The  $\bar{R}^2$  was 0.91).

The following variables, namely, area under banana, manure and human labour were found to influence yield significantly at one per cent level. The nutrient phosphorus was found to influence yield significantly at five per cent level. The results indicated that one per cent increase in the area under banana *Ceteris paribus* would increase the yield by 0.22 per

**Table 29. Resource use efficiency in production of banana by Kerala Horticulture Development Programme beneficiary farmers**

Sl.No.	Particulars	Estimated coefficients	Standard error
1.	Constant	5.1503**	0.4581
2.	Area (ha)	0.2212**	0.0776
3.	Manure (kg)	0.0689**	0.0185
4.	Nitrogen (kg)	0.0964	0.0894
5.	Phosphorus (kg)	0.1008*	0.0492
6.	Potassium (kg)	0.0541	0.0418
7.	Irrigation (Rs.)	0.0049	0.0241
8.	Plant protection chemicals (Rs.)	0.0071	0.0401
9.	Labour (mandays)	0.4975**	0.0979
10	R <sup>2</sup>	0.92	
11	$\bar{R}^2$	0.91	
12	n	90	

\*\* Significant at 1% level

\* Significant at 5% level

cent. Similarly one per cent increase in use of manure, *Ceteris paribus* would increase the yield by 0.07 per cent. Also, one per cent increase in use of labour in mandays, *Ceteris paribus* would increase the yield by 0.50 per cent and increase in use of phosphorus by one percent, *Ceteris paribus* would increase the yield by 0.1 percent. The returns to scale which worked out to 1.05 indicated constant returns to scale.

### (ii) Non-beneficiary Farmers

The results of the production function analysis for the non-beneficiary farmers are given in Table-30.

The coefficient of multiple determination ( $R^2$ ) at 0.90 indicated that 90 per cent of the variation in the dependent variable was explained by the explanatory variables included for the analysis. (The  $\bar{R}^2$  was 0.87).

The analysis would show that manure and human labour could positively influence yield of banana significantly at one per cent level. The major nutrient phosphorus was found to influence the yield significantly and negatively at five per cent level. The results would mean that one per cent increase in the use of manure *Ceteris paribus* would increase the yield by 0.60 per cent, increase in application of phosphorus by one per cent, *Ceteris paribus* would decrease the yield by 0.10 per cent and increase in the use of human labour by one per cent *Ceteris paribus* would increase the yield by 0.52 per cent. The sum of elasticities which worked out to 0.97 indicated constant returns to scale. The results indicated the

**Table 30. Resource use efficiency in production of banana by non-beneficiary farmers**

Sl.No.	Particulars	Estimated coefficients	Standard error
1.	Constant	1.9408**	0.7585
2.	Area (ha)	0.0245	0.0734
3.	Manure (kg)	0.5993**	0.1146
4.	Nitrogen (kg)	-0.0355	0.0943
5.	Phosphorus (kg)	-0.0994*	0.0488
6.	Potassium (kg)	-0.0519	0.0315
7.	Irrigation (Rs.)	0.0262	0.0779
8.	Plant protection chemicals (Rs.)	-0.0097	0.0995
9.	Labour (mandays)	0.5156**	0.1438
10	$R^2$	0.90	
11	$\bar{R}^2$	0.87	
12	n	30	

\*\* Significant at 1% level

\* Significant at 5% level

urgent need to rationalise the use of phosphatic fertilizers which negatively influenced the yield of banana.

#### **Analysis of Value of Marginal Product / Price, ratio**

To assess whether the resources were used rationally or otherwise, the ratio of value of marginal product to the input prices were worked out and the results are presented in Table-31. In the case of beneficiary farmers, the VMP-price ratios were 2.18, 8.36 and 4.48 for area under banana, nutrient phosphorus and the human labour used respectively, indicating the scope to increase further the use of these inputs. The VMP-price ratio for the manure, however, was only 0.89 indicating the need to reduce the use of manure.

The results for the non-beneficiary farmers indicated the scope to increase the use of manures and human labour in banana production as reflected by the VMP-price ratios of 8.13 and 3.18 respectively for these inputs. However, the negative value for the nutrient phosphorus indicated the need to rationalise use of phosphorus by the non-beneficiary farmers.

#### **(b) Technical efficiency - Stochastic Production Frontier using Maximum Likelihood Estimation Method**

Efficiency is an important concept in production economics when resources are meagre and opportunities for developing and adopting better technologies are competitive. Efficiency of a firm refers to its performance in the utilisation of resources at its disposal. It is also important to know,

**Table 31. Estimation of over use/under use of inputs by sample farmers**

Sl. No.	Inputs	Beneficiaries			Non-beneficiaries		
		VMP	P <sub>x</sub>	VMP/P <sub>x</sub>	VMP	P <sub>x</sub>	VMP/P <sub>x</sub>
1.	Area (ha)	48518.2	22190	2.18	-	-	-
2.	Manure (kg)	0.74	0.83	0.89	6.75	0.83	8.13
3.	Phosphorus (Kg)	104.5	12.50	8.36	-75.65	12.50	-6.1
4.	Human labour (mandays)	537.2	120	4.48	381.8	120	3.18

- Note : 1. Marginal Physical Product was computed as follows,  
 Marginal Physical Product = Elasticity x Average Product
2. VMP - Value of Marginal Product (Marginal Product valued at price of output)
3. P<sub>x</sub> - Prices of respective inputs (in case of area rental values paid by the farmers)

how well the resources are being utilised and what possibilities exist for improving the operational efficiency in the face of overall resource scarcity.

Efficiency studies showed that it is possible to raise productivity by improving the level of efficiency without actually increasing the resource use. Estimates on the extent of inefficiency could also help to decide whether to improve efficiency or to develop new technologies to raise agricultural productivity.

In the present study, the stochastic frontier function of Cobb-Douglas form was estimated separately for the beneficiary and non-beneficiary farmers using Maximum Likelihood Estimation Method.

The skewness was worked out to assess the extent of deviations from the maximum yield for both the beneficiary and non-beneficiary farmers and the results are presented in Table-32. The high level of skewness implied that yield of many of the farmers were less than the maximum possible yield and thereby indicating the existence of further scope to increase the yield (frontier level) with the existing level of inputs.

#### **(i) Maximum Likelihood Estimates for Beneficiary Farmers**

The results of the Maximum Likelihood Estimates are presented in Table-33. It could be seen that the variance of one sided error term ( $\sigma^2_u$ ) and symmetric error term ( $\sigma^2_v$ ) were 0.10271 and 0.00002 respectively which implied that the one sided error term was dominant which measured the shortfall of output from the maximum possible yield. The ratio of one

**Table 32. Level of skewness in yield**

Sl.No.	Farmers	Mean (Kg/hectare)	Median (Kg/hectare)	Skewness = [3(Mean- Median)]/Std. deviation
1.	Beneficiaries	21935.28	22500.07	-0.391
2..	Non beneficiaries	10250.65	11156.81	-0.725

**Table 33. Estimates of stochastic frontier function  
(beneficiary farmers)**

Sl.No.	Explanatory variables	Parameters values
1.	Constant	5.6230** (0.6899)
2.	Area (ha)	0.08328 (0.09004)
3.	Manure (kg)	0.11430** (0.0221)
4.	Nitrogen (kg)	0.0854 (0.09779)
5.	Phosphorus (kg)	0.11490 (0.07774)
6.	Potassium (kg)	0.11312 (0.07057)
7.	Irrigation (Rs.)	-0.03254 (0.87760)
8.	Plant protection chemicals (Rs.)	-0.08158 (0.1003)
9.	Labour (mandays)	0.4539** (0.1706)
10	$\sigma^2u$	0.10271
11	$\sigma^2v$	0.00002
12	$\lambda = \sigma u / \sigma v$	80.190
13	$\theta = \sigma^2u / (\sigma^2u + \sigma^2v)$	0.999
14	$MTE = 1 - \sigma u \sqrt{2/\pi}$	0.7442

\*\* Significant at 1% level

\* Significant at 5% level

(Standard error of the estimates are given in parentheses)

sided error term to symmetric error term ( $\lambda$ ) worked out to 80.190 which implied that the standard error of one sided error term was greater than the standard error of symmetric error term.

The estimates of the discrepancy parameter ( $\theta$ ) indicated that 99 per cent of the differences between the actual output and the maximum possible output were due to the differences in technical efficiencies of farmers. The mean technical efficiency (MTE) at 0.7442 implied that the yield of banana was 25.6 per cent less than the maximum possible output, thus, showing scope for further increasing the productivity of banana at the existing level of input use.

#### **(ii) Maximum Likelihood Estimates for Non Beneficiary Farmers**

The variance of one sided error term ( $\sigma^2u$ ) and symmetric error term ( $\sigma^2v$ ) were 0.29282 and 0.00000116, respectively (Table 34), which implied that the one sided error term was dominant which measured the shortfall of output from the maximum possible yield. The ratio of one sided error term to symmetric error term ( $\lambda$ ) worked out to 503.37 which implied that the standard error of one sided error term was greater than the standard error of symmetric error term.

The estimates of the discrepancy parameter ( $\theta$ ) indicated that 99 per cent of the differences between the actual output and the maximum possible output were due to the differences in technical efficiencies of farmers. The mean technical efficiency (MTE) was 0.5681 which implied that the yield of banana was 43.2 per cent less than the maximum possible output. Thus,

**Table 34. Estimates of stochastic frontier function  
(non beneficiary farmers)**

Sl.No.	Explanatory variables	Parameters values
1.	Constant	2.0701 (1.551)
2.	Area (ha)	-0.33012 (0.3076)
3.	Manure (kg)	0.66548** (0.1415)
4.	Nitrogen (kg)	0.33086* (0.1514)
5.	Phosphorus (kg)	0.33270** (0.08864)
6.	Potassium (kg)	-0.0019 (0.07493)
7.	Irrigation (Rs.)	-0.0007816 (0.1370)
8.	Plant protection chemicals (Rs.)	-0.00487 (0.1505)
9.	Labour (mandays)	-0.66647** (0.1686)
10	$\sigma^2u$	0.29282
11	$\sigma^2v$	0.00000116
12	$\lambda = \sigma u/\sigma v$	503.37
13	$\theta = \sigma^2u/(\sigma^2u + \sigma^2v)$	0.999
14	$MTE = 1 - \sigma u \sqrt{2/\pi}$	0.5681

\*\* Significant at 1% level

\* Significant at 5% level

(Standard error of the estimates are given in parentheses)

the technical efficiency revealed the tremendous scope for increasing the productivity of banana at the existing level of input use for the non-beneficiary farmers.

A comparative analysis of the mean technical efficiency (MTE) of beneficiary and non-beneficiary farmers revealed that the beneficiaries had operated at a relatively high level of mean technical efficiency as compared to the non beneficiaries, however, there existed scope to increase efficiency in both the categories.

## Summary & conclusion

## CHAPTER VI

### SUMMARY AND CONCLUSION

The Kerala Horticulture Development Programme (KHDP) is implemented by the Government of Kerala with the financial assistance from the European Economic Community (EEC). The project is under implementation from the year 1993. The major objective of the KHDP is to improve and stabilise the income of horticultural farmers.

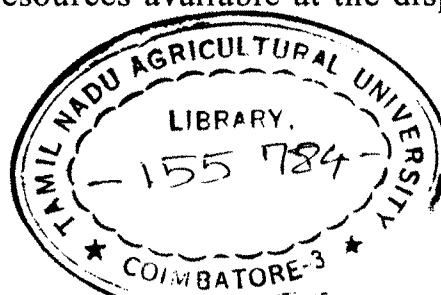
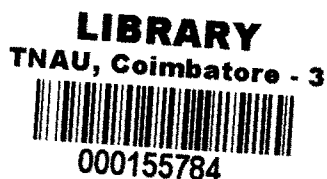
The principal components of the project are : (i) Formation of selfhelp groups to promote organisational and management skills among farmers, (ii) Extending credit through nationalised banks by creating a revolving fund, (iii) Promotion of marketing efforts by creating field centres to provide market information and to reduce marketing cost for the realisation of better prices, (iv) Research backup to promote development of appropriate technology packages to promote pest and disease surveillance activities to prevent possible outbreaks and indiscriminate and overuse of pesticides, (v) Supply of quality seeds, (vi) Training of farmers and extension functionaries based on need and feed back and (vii) Promoting agro processing.

The project is implemented through the formation of the Self Help Groups with the aim of promoting the cultivation of horticultural crops and thereby enhancing the income of the farmers. The various functions of the

SHGs are organised by the Master farmers incharge of technology, credit and marketing which are co-ordinated by the Technical officers of the KHDP. The success of the project can be assessed through examining the levels of achievements relating to the different hierarchy of the objectives of the project which may be delineated as follows.

- i. Successful formation and functioning of the Self Help Groups with all its inherent aims or goals mentioned earlier.
- ii. The levels of adoption of recommended technology and the benefits that accrued to the farmers through the various components of the project as indicated above.
- iii. The higher use-efficiency of resources achieved by the beneficiary farmers.
- iv. The overall improvement in the socio-economic status of the target groups.
- v. The macro-economic implications and the environmental impacts caused by the project in a broader frame work.

The project had been under implementation during the past six years from 1993 and therefore, it was felt, an evaluation of impact at this stage would be more appropriate. The present study, however, confined itself to looking at only the impact at the intermediate level, in the hierarchy of the project objectives, given the time and resources available at the disposal of



the researcher. The study was again confined to the major crop, banana under fruits, for better focus.

The overall objective of the study was to assess the benefits that accrued to the farmers in terms of optimum use of resources, easy and adequate credit and better price realised through marketing arrangements made under the programme.

The specific objectives of the study included the following:

- i. To assess the differences in the crop composition, with specific reference to the area under banana for the beneficiary and non-beneficiary farmers.
- ii. To assess the extent of adoption of production technologies advocated under KHDP for banana.
- iii. To assess the extent of use and benefit of credit and marketing facilities created under KHDP for banana.
- iv. To assess the levels of income for the beneficiary and non-beneficiary farmers.
- v. To assess the resource use efficiency in cultivation of banana by the beneficiary and non-beneficiary farmers.

The study was taken up in Ernakulam District of Kerala, one of the three districts chosen in the first phase of the project, where the area under banana was relatively higher. Six panchayats were randomly selected from

a list of 17 Panchayats covered under the project with banana. A total of 90 beneficiaries under the programme and 30 non-beneficiaries were selected to enable comparative analysis. A two way analysis of variance test indicated that there was no significant difference in yield of banana between different size groups and among villages. Therefore, the data were pooled for analysis.

The findings of the study are summarised below.

### **I. GENERAL DESCRIPTION OF SAMPLE HOUSEHOLDS**

The respondents were mostly in the age group of more than 35 years. But farmers, in the age group of less than 35 years also constituted a considerable 21.7 per cent. The gender composition of the heads of households indicated that 98.3 per cent were male farmers and only 1.7 per cent were female farmers. All the respondents were literates. Most of them had education upto upper primary level (55.0 per cent) and 30.8 per cent had education at high school level for the pooled sample.

The land holding pattern indicated that 93.4 per cent were small farmers with less than 1 hectare in the beneficiary group and they constituted 86.7 per cent in the non-beneficiary group. The average size of holding was 0.6 hectares and 0.77 hectares for beneficiary and non-beneficiary group, respectively.

## **II. IMPACT ANALYSIS**

The impact analysis of the programme was made with specific reference to the objectives of the study.

### **(1) Cropping pattern**

The study revealed that banana was the major crop which occupied 38.6 per cent of total cropped area for the beneficiary farmers. Paddy was the predominant crop with 73.4 per cent of total cropped area for the non-beneficiary farmers. The study clearly indicated that the beneficiary farmers put more area under banana and vegetables, partially replacing the area under paddy.

### **(ii) Extent of adoption of production technologies**

The percentage of farmers adopting the recommended technologies and the deviations in the quantity of inputs used from the recommended levels were computed to assess the extent of adoption of technologies. The analysis indicated that the number of beneficiary farmers adopting the recommended practices were uniformly higher and the deviations in the quantity of inputs used were much lower for the beneficiary farmers as compared to that of non-beneficiary farmers.

### **(iii) Extent of use of credit facilities**

The beneficiary farmers had better access to credit extended by the designated commercial bank branches. All the respondent farmers availed

the credit and the average credit availed was Rs.23688 per farm and Rs.39251 per hectare. As regards the non beneficiaries only 23.3 per cent of the farmers availed credit from the commercial banks and co-operative banks. The average credit availed by them was only Rs.3333 per farm and Rs.4329 per hectare.

**(iv) Use of Marketing facilities for banana under Kerala Horticulture Development Programme**

Among the six study panchayats, three panchayats could market their produce through field centres established under KHDP apart from other sources. The results showed that 28.9 per cent of the beneficiary farmers could utilize the marketing centres which benefited them in terms of the net price realised after accounting for the marketing cost. The beneficiary farmers could realise a net benefit of Rs.42.50 per quintal while selling through field centre as compared to nearby market, Rs.135 per quintal and Rs.89.75 per quintal respectively, while selling through traders and local shops.

**(v) Income of the sample households**

The results showed that 62.5 per cent of the total income was constituted by the on farm income of which the income from banana accounted for 75.7 per cent in the case of beneficiaries. The on farm income constituted only 34.6 per cent for the non-beneficiary farmers. The results indicated that the income from crops for the beneficiary farmers

were 2.57 times higher than the non-beneficiary farmers. The difference in income from banana made the difference in total income between the beneficiary and non-beneficiary farmers.

**(vi) Resource Use Efficiency of Beneficiary and Non-beneficiary farmers**

**(a) Inputs used and yield realised by beneficiary and non-beneficiary farmers.**

The quantum of inputs used and the yield realised by beneficiary farmers were much higher than the non-beneficiary farmers. The cost of cultivation, the yield realised per hectare and value of the bunches were at Rs.67230, 21935 Kg and Rs.219350 for beneficiary farmers as compared to Rs.38136, 10250 Kg and Rs.102500 for non-beneficiary farmers, respectively.

**(b) Resource Use Efficiency in Production of Banana - Production Function Analysis**

The production function analysis revealed that area under banana, manure, nutrient phosphorus used and labour influenced yield of banana significantly. The coefficients for all these variables were found to be positive for the beneficiary farmers.

For the non-beneficiary farmers while manures and labour were found to have positive influence at one per cent significance level, the

nutrient phosphorus was found to have negative influence on yield at five per cent significance level. The sum of production elasticities had indicated constant returns to scale for both the groups.

**(c) The ratio of value of marginal product to input price**

While the production elasticities and the marginal products derived for each of the variable inputs having significant influence on yield could indicate the physical optima, the farmer could take a decision on the level of use of these inputs, bearing in mind the ratio of the value of marginal product to the prices of the respective inputs. This would mean that the farmers should be guided by the rule that the ratio of Marginal Revenue to Marginal Cost (in the present analysis the ratio of value of marginal product to the price of the respective input) equals one.

In the case of beneficiary farmers the VMP/price ratios at 2.18, 8.36 and 4.48 for area under banana, nutrient phosphorus applied and labour used indicated the scope to increase their use further. The ratio of 0.89 for manure used indicated the need to rationalise the use of manure. The non-beneficiary farmers had scope to increase the use of manures and labour as indicated by the VMP/Price ratio of 8.13 and 3.18. They needed to rationalise the use of phosphorus which negatively influenced the yield of banana.

**(d) Technical Efficiency Analysis using the Stochastic production Frontier**

The Stochastic production frontier was estimated using the Maximum Likelihood Estimation Method. The mean technical efficiency derived from the analysis was 0.744 for beneficiary and 0.568 for non-beneficiary group of farmers. This indicated that the Mean Technical Efficiency for the beneficiary farmers was 74.4 per cent. Alternately this would mean the actual yield was 25.6 per cent less than the maximum possible yield. For the non-beneficiary farmers, the Mean Technical Efficiency was 56.8 per cent and this would mean that the actual yield was less by 43.2 per cent than the maximum possible yield. The results indicated both the higher level of efficiency for the KHDP beneficiaries and the scope to increase production by both the groups of farmers at the existing level of input use.

The results of the study could prove the hypotheses that

- i. the farmers covered under KHDP were relatively more efficient than the non-beneficiaries.
- ii. the farmers covered under KHDP had easy access to credit.
- iii. the farmers covered under KHDP could realise better prices for their produce.

## CONCLUSION

The results would show that ;

- i. The beneficiary farmers allocated more area under banana (38.6 per cent) and vegetables (23.3 per cent) covered under KHDP, in preference to paddy which occupied only 21.74 per cent as against 73.4 per cent of the area allocated by the non-beneficiary farmers for paddy.
- ii. The extent of adoption of technologies was at a higher level for the beneficiary farmers which were closer to the recommended levels for major inputs like the suckers, manure and fertilizers applied, as compared to that of the non-beneficiary farmers.
- iii. All the beneficiary farmers had access to credit and they availed credit as against only 23.3 per cent in the case of non-beneficiaries. The average credit availed by the beneficiary farmers was also 8.07 times higher than that of the non-beneficiary farmers.
- iv. The beneficiary farmers had opportunity to sell through the KHDP field centres and 28.9 per cent of them actually used these centres. The net price realised through KHDP field centres, after accounting for differences in price and marketing charges was positive and higher as compared to other channels of marketing.
- v. The average income realised by the beneficiary farmers was at Rs.72122.69 as compared to Rs.36713.93 realised by the non-beneficiary

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farmers. The difference in total income was on account of the difference in on-farm income mostly constituted by income from banana.

vi. The production function analysis for the beneficiary farmers revealed the scope to increase the area under banana, use of the nutrient phosphorus and human labour and to rationalise the use of manures. For the non-beneficiary farmers, there was scope to enhance the use of manures and the human labour. The coefficient for the nutrient phosphorus was negative and significant indicating the need to exercise caution in using this particular input.

vii. The mean technical efficiency at 74.4 per cent for the beneficiary farmers and at 56.8 per cent for the non-beneficiary farmers revealed that the farmers covered under KHDP were relatively more efficient in banana cultivation. The results would also reveal the scope to further improve the technical efficiency for both the category of farmers.

## **POLICY OPTIONS**

1. The beneficiary farmers under KHDP had put more area under banana and vegetables, obviously in preference to paddy as reflected by the crop composition of the non-beneficiary farmers. Kerala being chronically deficient in rice, such a programme with the objective of bringing in more area under horticulture crops, though would benefit largely the farmers, necessitates appropriate policies on food grain distribution, especially with

reference to rice, to be in place, as rice happens to be the staple food crop in the state.

2. The credit and marketing facilities created under KHDP seemed to help the participant farmers in a large way. However only 28.9 per cent of the KHDP beneficiary farmers utilized the marketing facilities provided under the project. Though there was no difference in the price realised from the KHDP field centres and the regular market centres, still, the marketing cost was lower in the KHDP centres. However, a majority of 43.3 per cent of beneficiary farmers used only the market centres. This indicated the need to have appropriate promotional measures to encourage more farmers to use the KHDP field centres to market their produce. The number of such KHDP field centres may also be increased as there were only two centres for the six villages covered for the study.

3. As regards the use of inputs such as the planting materials, manures and fertilizers, the difference between the recommended levels and the actual use for the beneficiary farmers was minimum and hence the technology transfer component of the project seemed to work satisfactorily. However, there is need to look closely the various agronomic practices followed in banana cultivation as there is still more scope to improve the efficiency in use of different inputs, as reflected by the mean technical efficiency of 74.8 per cent for the beneficiary farmers. This is because, studies have shown that the mean technical efficiency could be as high as

89.5 per cent computed for the potato producers in the United Kingdom<sup>69</sup> and 86.28 per cent computed for the sericulture enterprises in the Dharmapuri district of Tamil Nadu, India<sup>70</sup>.

This implies the need for more close interaction by the technical officers of the KHDP with the farmers, to obtain feed back on the various management problems relating to agronomic practices in the process of use of the inputs, so as to impart necessary training to the master farmers in charge of technology, to enable them to advise others in the group.

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<sup>69</sup>Paul Wilson, Dave Hadley, Stephen Ramsden and Ioannis Kaltas, **Op. Cit.**, p.294-305.

<sup>70</sup>Panda, R.C., **Op. Cit.**, p.355-364.

# **Bibliography**

## BIBLIOGRAPHY

### BOOKS

- Ahuja, H.L., **A Text book of Modern Economics**, (New Delhi : S.Chand & Company Ltd., 1979), p.279.
- Aravindakshan, M. and K. Pushkaran, **Banana compendium**, (Thrissur : Directorate of Extension, Kerala Agricultural University, 1996), p.1.
- Bishop, C.E. and W.D. Toussiant, **Agricultural Economic Analysis**, (Newyork : JohnWiley & Sons Inc., 1958), p.29.
- Bishop, C.E. and W.D. Toussiant, **Introduction to Agricultural Economic Analysis**, (Tokyo: Toppan Company Ltd., 1972), p.30.
- Ferguson, C.E., **Micro Economic Theory**, (U.S.A. Home Wood Illinois, 1982), p.97.
- Gulathi, A., A. Sharma, K. Sharma, S. Das and V. Chhabra, **Export Competitiveness of Selected Agricultural Commodities**, (New Delhi : National Council of Applied Economic Research, 1994), pp : 133-135.
- Handerson, J.M. and R.E. Quant, **Micro Economic Theory - A Mathematical Approach**, (Tokyo : McGraw Hill, Kogakusha Ltd., 1971), p.54.
- Heady, E.O. and J.L. Dhillon, **Agricultural Production Functions**, (Ames: Iowa State University Press, 1961), p. 228.
- Heady, E.O., **Economics of Agricultural Production and Resource Use**, (New york: Engle wood Cliffs, M.J. Prentice Hall Inc. 1957), p.98.
- Johl, S.S. and T.R. Kapur, **Fundamentals of Farm Business Management**, (Delhi: Kalyani Publishers, 1981), p.315.
- Kaplin, H.T., **Micro-Economic Analysis-Welfare and Efficiency in Private and Public Sector**, (New York: Harper and Row Publishers, 1971), p.89.
- Koutsoyiannis, A., **Modern Micro Economics**, (Hongkong: The McMillan Ltd., London, 1983), pp.105-106.
- Nerin, E.T., **A text book of Economic Analysis**, (London: Macmillan Eduction Ltd., 1971), p.3.

Samuelson, P.H., **Economics**, (Tokyo: McGraw Hill, Kogakusha Limited, 1973), pp. 64-65.

Stigler, J.C., **Price Theory**, (Tokyo: Mc.Graw Hill Kogakusha Ltd., 1947), p. 109.

### JOURNALS/PERIODICALS

Aigner, D.J., C.A.K. Lovell and P. Schmidt, "Formation and Estimation of Stochastic Frontier Production Function Models", **Journal of Econometrics**, 6 : 21-37, 1977.

Ali, M. and M.A. Chaudhry, "Inter-regional Farm Efficiency in Pakistan's Punjab : a Frontier Production Function Study", **Journal of Agricultural Economics**, 41(1) : 62-74, 1990.

Arindam Banik, "Technical Efficiency of Irrigated Farms in a Village of Bangladesh", **Indian Journal of Agricultural Economics**, 49(1) : 72, 1994.

Ayanwale, A.B. and C.O. Isijola, "Farm Size and Economic Efficiency : The Case of Some Selected Farms in Osun State of Nigeria", **Indian Journal of Economics**, 67 (307) : 551-566, 1997.

Battese, G.E. and G.A. Tessema, "Estimation of Stochastic Frontier Production Function with Time Varying Parameters and Technical Efficiencies using Pad Data from Indian Villages", **Agricultural Economics**, 9:314, 1992.

Battese, G.E., "Frontier Production Function and Technical Efficiency - a Survey of Empirical Applications in Agricultural Economics", **Agricultural Economics**, 7: 185-208, 1992.

Battese, G.E., Sohail.J. Malik and Manzoor A. Gill, "An Investigation of Technical Inefficiencies of Production of Wheat Farmers in Four Districts of Pakistan", **Journal of Agricultural Economics**, 47(1) : 37-49, 1996.

Bhat, G.M. and M.P. Dhar, "Resource Use Efficiency of Apple Cultivation in Jammu and Kashmir State", **Indian Journal of Economics**, 69(272) : 51-58, 1988.

Broek, J.V.D., F.R., Forsund, Lennart, Hjalmarsson and Wim Meevsen, "On the Estimation of Deterministic and Stochastic Frontier Production Functions", **Journal of Econometrics**, 13: 117-138, 1980.

Farrell. M.J., "The Measurement of Productive Efficiency:", **Journal of the Royal Statistical Society**, A120 253-281, 1957.

- Forsund, F.R., C.A.K. Lovell and Peter Schmidt, "A Survey of Frontier Production Functions and of their Relationship to Efficiency Measurement", **Journal of Econometrics**, 13: 5-15, 1980.
- Heshmati A. and S.C. Kumbhakar, "Estimation of Technical Efficiency in Swedish Crop Farms : A Pseudo Panel Data Approach", **Journal of Agricultural Economics**, 48(1) : 22-37, 1997.
- Jayaram, H., G.S. Chandrashekar and Lalith Achoth, "An Economic Analysis of Technical Efficiency in Rice Cultivation in Mandya : Some Issues in Resource Pricing", **Indian Journal of Agricultural Economics**, 47(4) : 678-682, 1992.
- Khan, B.A. and S.A. Alam, "Impact of Technological Change on Size Productivity Relationship and Resource Use Efficiency in Kashmir Agriculture", **Agricultural Situation in India**, 43(4) : 301-307, 1988.
- Khusro, A.M., "Returns to scale in Indian Agriculture", **Indian Journal of Agrl. Economics**, 19 (3 & 4): 51-80, 1964.
- Kumbhakar, B.C., "Efficiency Estimation in a Profit Maximising Model Using Flexible Production Function", **Agricultural Economics**, 10(2) : 143, 1994.
- Kutavla, S.S., "Application of Frontier Technology to Wheat Crop grown on Reclaimed Soils". **Indian Journal of Agricultural Economics**, 48(2) : 226-236, 1993.
- Lata, S., Y. Agnihotri and S.P. Mittal, "Impact of Lab to Land Programme in Shivalik Foot Hill Villages - a Case Study", **Agricultural Situation in India**, 44(9) : 695-699, 1989.
- Mattigatti, R., H.G.S. Murthy, G.K. Hiremath and S. Mallikarjunappa, "Resource Productivity in Cow Milk Production - an Impact of Operation Flood Programme", **Indian Cooperative Review**, 30(2) : 145-153, 1993.
- Mirotschie and D.B. Taylor, "Resource Allocation and Productivity of Cereal State Farms in Ethiopia", **Agricultural Economics**, 8(3) : 187-197, 1993.
- Misra, S.R., "Resource Use Efficiency in Tea Plantations, **Agricultural Situation in India**, 46(11) : 807-810, 1992.
- Muraleedharan, P.K., "Resource Use Efficiency in Kolelands in Trichur District - Kerala", **Indian Journal of Agricultural Economics**, 42(4) : 578-586, 1987.

- Olsen, J.A., and P.L. Schmidt, "A Monte Carlo Study of Estimators of Stochastic Frontier Production Functions", **Journal of Economics**, 13(1) : 67-82, 1980.
- Panda, R.C., "Efficiency and Productivity - The Case of Sericulture Farms in Tamil Nadu" **Indian Journal of Agricultural Economics**, 51(3) : 355-364, 1996.
- Paul Wilson, Dave Hadley, Stephen Ramsden and Ioannis Kaltas, "Measuring and Explaining Technical Efficiency in UK Potato Production", **Journal of Agricultural Economics**, 49(3) : 294-305, 1998.
- Rana, R.K., S.C. Tiwari and K.K. Raina, "Resource Use Efficiency in Seed Potato Production", **Economic Affairs**, 38(3) : 168-172, 1993.
- Rao, N.C., V.T. Raju, D.V.S. Rao and S.M. Shareef, "Impact of Commercialisation of Agriculture on Resource Use Efficiency in Prakasam District of Andhra Pradesh", **Economic Affairs**, 36(4) : 214-222, 1991.
- Reddy, N.R.V., "Technological Parameters in Paddy Production Function : A Case Study of Cuddapah District of Andhra Pradesh", **Indian Journal of Economics**, 75(4) : 497-503, 1995.
- Schmidt, P. and C.A.K. Lovell, "Estimating Technical and Allocative Inefficiency Relative to Stochastic Production and Cost Frontiers", **Journal of Econometrics**, 9: 343-366, 1979.
- Shanmugam, T.R. and K. Palanisami, "Measurement of Economic Efficiency - Frontier Function Approach", **Journal of the Indian Society of Agricultural Statistics**, 45(2) : 125-242, 1993.
- Sharma, H.R., S.K. Sharma and R.C. Bhardwaj, "Impact of Lab-to-Land Programme - a Study of Marginal Farms", **Agricultural Situation in India**, 41(7) : 547-550, 1986.
- Sharma, R. and V. Moorti, "Resource Use Productivity in Tea Farming in Himachal Pradesh : A Regional Study", **Indian Journal of Regional Science**, 26(1) : 87-93, 1994.
- Singh, K.V., S. Kumar and R.N. Malik, "Resource Use Efficiency of Sugarcane Farms (A Micro level Study of Western Uttarpradesh)", **Cooperative Sugar**, 25(1/2) : 43-45, 1993.
- Tadesse B. and S. Krishnamoorthy, "Technical Efficiency in Paddy Farms of Tamil Nadu : An Analysis Based on Farm Size and Ecological Zone", **Agricultural Economics**, 16(3) : 185-192.

- Tewari, S.C. and R.K. Sharma, "Effect of Technological Change on Hill Agriculture", **Himachal Journal of Agricultural Research**, 10(2) : 53-60, 1984.
- Tiwari, R. and D.P. Dheer, "Resource Use Efficiency of Ratoon : Sugarcane Farms in North Bihar", **Indian Sugar**, 44(2) : 109-111, 1994.
- Tran Vo Hung Son, Tim Coelli and Euan Fleming, "Analysis of Technical Efficiency of State Rubber Farms in Vietnam", **Agricultural Economics**, 9(3) : 183-201, 1993.
- Tripathi, R.S., "Rapeseed Cultivation in Rainfed Hill Farming : A Case Study", **Indian Journal of Agricultural Research**, 29(1/2) : 10-14, 1995.
- Ureta, B.E. and L. Riegr, "Alternative Production Frontier Methodologies and Dairy Farm Efficiency", **Journal of Agricultural Economics**, 41(2): 218-219, 1990.
- Velayudham, K. and P. Zeaudeen, "Resource Use Efficiency in Sesame Production", **Agricultural Situation in India**, 48(9) : 661-664, 1993.

### UNPUBLISHED THESES/DISSERTATIONS

- Bastine, L.C., "Irrigation Investments in Small Holder Plantation Crops of Kerala - An Economic Appraisal" (Unpublished Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore, 1994).
- Rajendran, G., "A study on the Economics of production and Resource use efficiency in chillies of Satur taluk, Ramanathapuram district". (Unpublished M.Sc Ag. thesis submitted to TNAU, Coimbatore, 1978).

### OTHER REPORTS

- Directorate of Economics and Statistics, Panchayat Level Statistics - Ernakulam District, Govt. of Kerala, Thiruvananthapuram, 1995.
- Farm Information Bureau, Farm Guide, Govt. of Kerala, Thiruvananthapuram, 1998.
- Ministry of Foreign Affairs, Evaluation Report-Agricultural Sector Evaluation, Danida, 1:5, 1994.

# Appendix

## Appendix-I

## Results of two way ANOVA (Beneficiary farmers)

Source of variation	S.S.	D.F.	M.S.	F	Significance of F
Main effect	143750651.746	6	23958441.958	1.999	0.116
Village	141451928.896	5	28290381.779	0.2360	0.079
Size	6148075.41	1	6148075.471	0.513	0.483
2 way interactions	36356046.494	4	9089011.623	0.758	0.565
Village size	36356046.494	1	9089011.623	0.758	0.565
Explained	180106698.240	10	18010669.824	1.502	0.213
Residual	227757404.110	19	11987231.795		
Total	407864102.350	21	14064279.391		

## Appendix-II

## Results of two way ANOVA (Non-beneficiary farmers)

Source of variation	S.S.	D.F.	M.S.	F	Significance of F
<b>Main effects</b>	124700945.463	6	20783490.911	1.083	0.380
Village	60949837.794	5	12189967.559	0.635	0.674
Size	51515105.631	1	51515105.631	2.684	0.105
<b>2 way interactions</b>	53170660.163	5	10634132.033	0.554	0.735
Village size	53170660.163	5	106341132.033	0.554	0.735
<b>Explained</b>	177871605.27	11	16170145.966	0.842	0.599
<b>Residual</b>	1497219010.07	78	19195115.54		
<b>Total</b>	1675090615.70	89	18821242873		

**Appendix-III**  
**Area, production, productivity of banana (nendran) over years**

Year	Area Kerala (hectares)	Area Ernakulam (hectares)	Production Kerala (tonnes)	Production Ernakulam (tonnes)	Productivity Kerala (tonnes/ hectare)	Productivity Ernakulam (tonnes/ hectare)
75-76	11155	1361	81273	9917	7.29	7.29
76-77	11162	1149	81326	8372	7.29	7.29
77-78	11379	1253	130679	14644	11.48	11.69
78-79	12459	1289	140869	14928	11.31	11.58
79-80	13349	1300	151821	14999	11.37	11.54
80-81	13942	1312	166683	15017	11.96	11.45
81-82	14329	1413	170998	16892	11.93	11.96
82-83	14998	1632	177210	21454	11.82	13.15
83-84	15138	1836	177917	23354	11.75	12.72
84-85	16123	2145	189564	26465	11.76	12.34
85-86	16500	2130	215646	26851	13.07	12.61
86-87	18724	2308	219104	25573	11.71	11.08
87-88	18939	2390	249933	33742	13.19	14.12
88-89	20496	2600	262381	35644	12.80	13.71
89-90	20991	2572	274760	35193	13.09	13.68
90-91	22099	2991	295145	41233	13.36	13.79
91-92	22602	3276	303090	43849	13.41	13.39
92-93	23667	3471	308871	46085	13.05	13.28
93-94	23850	3187	339994	44825	14.26	14.06
94-95	25151	2757	342006	34591	13.59	12.55
95-96	26267	2529	362919	33438	13.82	13.22

**ABSTRACT****SREEKUMAR .K (1999)****IMPACT OF KERALA HORTICULTURE DEVELOPMENT  
PROGRAMME ON RESOURCE USE EFFICIENCY IN BANANA  
(NENDRAN) PRODUCTION IN ERNAKULAM DISTRICT.****(Dr.M. Chandrasekaran)**

The present study on the impact of Kerala Horticulture Development Programme on resource use efficiency in banana production is undertaken with the overall objective to assess the benefits that accrued to the farmers, in terms of optimum use of resources, cheap and easy credit and better price realised through the marketing arrangements made under the Programme.

A sample of 90 beneficiary and 30 non-beneficiary farmers were covered from six villages chosen randomly in Ernakulam District of Kerala. The respondents were mostly in the age group of more than 35 years and young farmers below 35 years of age constituted 21.7 percent. Male farmers constituted 98.3 percent of the total sample. The literacy rate was 100 per cent for the selected sample. The farmers were mostly small farmers with less than one hectare of area and constituted 93.4 per cent in beneficiary group and 86.7 per cent in non-beneficiary group. The average size of the holding was 0.60 hectare and 0.77 hectare for beneficiary and non-beneficiary farmers, respectively.

The beneficiary farmers allocated more area under banana (38.6 per cent) and vegetables (23.3 per cent): the crops are covered under KHDP in

preference to paddy which occupied only 21.74 per cent as against 73.4 per cent of the area allocated by the non-beneficiary farmers. With rice being the staple food crop of the state, the need for appropriate policies to be in place to manage the food grains distribution to the public has become imperative.

The extent of adoption of technologies was at a higher level for the beneficiary farmers which were closer to the recommended levels for major inputs like the planting material and manures and fertilizers applied as compared to the non-beneficiary farmers.

All the beneficiary farmers had access to credit and they availed credit as against only 23.3 per cent in the case of non-beneficiaries. The average credit availed by the beneficiary farmers was also 8.07 times higher than that of the non-beneficiary farmers. This only indicated the fact that the present system followed under KHDP is functioning successfully which can be continued in future and can be extended to all the areas under similar arrangements.

The beneficiary farmers had opportunity to sell through the KHDP field centres. But only 28.9 per cent of them actually used these centres inspite of the fact that the net price realised through KHDP field centres, after accounting for differences in price and marketing changes was positive and higher as compared to nearby markets or other sources of disposal. This indicated the need for taking up more promotional measures to encourage more farmers to use these centres. Such centres may also

allow the non-beneficiary farmers to sell their produce through these centres.

The average income realised by the beneficiary farmers was at Rs.72122.69 as compared to Rs.36,713.93 realised by the non-beneficiary farmers. The difference in total income was on account of the difference in on-farm income mostly constituted by income from banana.

The production function analysis and the VMP/price ratio analysis, for the beneficiary farmers revealed the scope to increase; i) the area under banana, ii) the use of the nutrient phosphorus, iii) the use of human labour and iv) to rationalise the use of manures. For the non-beneficiary farmers, there was scope to enhance the use of manures and the human labour. The returns to the nutrient phosphorus was negative and significant indicating the need to exercise caution in using this particular input.

The mean technical efficiency at 74.4 per cent for the beneficiary farmers and at 56.8 per cent for the non-beneficiary farmers revealed that the farmers covered under KHDP were relatively more efficient in banana cultivation. The results would also reveal the scope to further improve the technical efficiency. The KHDP may take up a survey on the various agronomic and management practices followed by the beneficiary farmers with the help of the technical officers, to fine tune these practices and improve the technical efficiency. The master farmers in charge of technology can be trained subsequently to enable them to advise other farmers.

## RESEARCH FINDINGS

SREEKUMAR .K (1999)

### IMPACT OF KERALA HORTICULTURE DEVELOPMENT PROGRAMME ON RESOURCE USE EFFICIENCY IN BANANA (NENDRAN) PRODUCTION IN ERNAKULAM DISTRICT

(Dr.M. Chandrasekaran)

The results of the study entitled, "Impact of KHDP on resource use efficiency in Banana (Nendran) production in Ernakulam District" revealed that the beneficiary farmers allocated more area under banana (38.6 percent) and vegetables (23.3 per cent) compared to paddy (21.7 per cent) as against 73.4 percent of area allocated under paddy by non-beneficiary farmers. This indicated the need for policies to augment food grain supply in view of the fact that rice is the staple food crop and Kerala is chronically a rice deficit state. The extent of adoption of technologies was at a higher level for the beneficiary farmers. All the beneficiaries had access to credit and the average credit availed was Rs. 23668, which was eight times higher than non beneficiaries. The net price realised by the beneficiaries by selling through field centres under the programme was higher by Rs.42.50 per quintal after accounting for marketing cost compared to nearby markets. However, only 28.9 per cent of beneficiary farmers availed this facility indicating the need for more promotional measures to enable all the farmers to utilize this facility. The average farm income of Rs. 42861 realised by beneficiaries were much higher than the non beneficiaries which was Rs.12010 and the major share of the additional income was from banana. The production function and consequently, the efficiency analysis, revealed the scope to increase the area under banana, use of nutrient phosphorus and human labour, but to rationalise the use of farm yard manure for beneficiaries. The mean technical efficiency computed using the frontier production function revealed a relatively higher efficiency level of 74 percent for the beneficiary farmers as compared to the efficiency level of 56 per cent for non beneficiary farmers indicating while, the better performance by KHDP farmers, the existence of scope to further improve efficiency. The production function analysis also revealed the scope to increase the production of banana further.

