"A STUDY ON ECONOMIC ASPECTS OF IPM TECHNOLOGY IN GROUNDNUT PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH"

By

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CERTIFICATE

Mr. **S.SRI HARI NAIDU** has satisfactorily prosecuted the course of research and that the thesis entitled **"A STUDY ON ECONOMIC ASPECTS OF IPM TECHNOLOGY IN GROUNDNUT PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any university.

Date : 12-09-2000.

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CERTIFICATE

This is to certify that the thesis entitled **"A STUDY ON ECONOMIC ASPECTS OF IPM TECHNOLOGY IN GROUNDNUT PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH"** submitted in partial fulfilment of the requirements for the degree of Master of Science in Agriculture in the major field of **Agricultural Economics** of the Acharya N.G. Ranga Agricultural University, Hyderabad, is a record of the bonafide research work carried out by Mr. **S. SRI HARI NAIDU,** under our guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part has been fully acknowledged. All the assistance and help received during the course of the investigation have been duly acknowledged by the author of the thesis.

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S. Sri Hari Naidu.

Date: 12-09-2000 (S.Sri Hari Naidu)

DECLARATION

I, **S. SRI HARI NAIDU**, hereby declare that the thesis entitled **"A STUDY ON ECONOMIC ASPECTS OF IPM TECHNOLOGY IN GROUNDNUT PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH"** submitted to Acharya N.G. Ranga Agricultural University for the degree of Master of Science in Agriculture in the major field of **Agricultural Economics** is the result of original research work done by me. I also declare that any material contained in the thesis has not been published earlier.

S. Sri Hari Naidu.

Date : 12-09-2000 (S. SRI HARI NAIDU)

ABSTRACT

Name of the author	:	**S. SRI HARI NAIDU**
Title of the Thesis	:	**A STUDY ON ECONOMIC ASPECTS OF IPM TECHNOLOGY IN GROUNDNUT PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH.**
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Pesticides emerged as an important agricultural input with the advent of green revolution and development of hi-tech technology. The role of pesticides is indispensable in controlling pests. But, indiscriminate and excessive use of pesticides leads to pest resistance, pest resurgence, secondary pest outbreaks, general environmental pollution and ecological imbalance. To combat this situation, a co-ordinated and concerted approach called Integrated Pest Management (IPM) came into light, combining the various control measures like chemical, cultural, biological and mechanical to maximise economic benefits. In this context an attempt is being made to study economic aspects of IPM technology in groundnut production with the specific objectives, to study the relative resource use efficiency in groundnut production using IPM technology, to analyse the factors influencing IPM technology in groundnut production and to examine and identify the constraints in the adoption of IPM technology in production of groundnut.

Guntur district was purposively selected as IPM technology was implemented in groundnut in this district during 1992-'94. This covered two seasons by ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) and ANGRAU (Acharya N. G. Ranga Agricultural University) with the guidance of scientists of Krishi Vigyan Kendra, Kavur in four villages out of which three viz., Karlapalem, Ganapavaram and Nakkalavaripalem were from a mandal i.e. Karlapalem and one village viz., Kavur was from Cherukupalli mandal. These two mandals and four villages were selected purposively. In order to study the impact of IPM technology two non-IPM adopted villages viz., Chintayapalem from Karlapalem mandal and Ponnapalli from Cherukupalli mandal were randomly selected, which are situated 6-20 Km away from the IPM adopted villages. A sample of 120 farmers, of which 80 from four IPM adopted villages and 40 from two non-IPM adopted villages were selected by using proportionate random sampling technique. The sample farmers were interviewed personally with pre-tested and well-structured schedules. The data collected was pertaining to the agricultural year 1999-2000.

Results of tabular analysis revealed that IPM on groundnut yielded an additional gross (Rs. 4687.50) and net (Rs. 5273.33) returns besides saving Rs. 585.83 per hectare on cost of production. The rate of return per rupee of investment was more on farms with IPM practice. Cobb-Douglas production function was most suitable to study the relative resource use efficiency. It was also found that IPM technology contributed positively and significantly to gross income.

Decomposition analysis was employed to analyse the factors influencing IPM technology and it was noticed that the total change in income was due to technical change and not due to input change. Further, with no additional cost on resources, extra output was obtained and inputs were saved with IPM technology.

Friedman's test was applied to examine the constraints after identifying them for adoption of IPM. This was to ensure that there was no significant difference between the constraints. The computed test statistic value was found to be significant at 5 per cent level of probability indicating that each of the identified constraints has its own value in affecting the adoption of technology.

LIST OF ABBREVIATIONS AND SYMBOLS USED

ANGRAU	:	Acharya N. G. Ranga Agricultural University
Ceteris paribus	:	Other things being equal
et al.	:	and others
Fig.	:	Figure
FYM	:	Farm Yard Manure
ha	:	Hectare
ICRISAT	:	International Crops Research Institute for the Semi-Arid Tropics.
i.e.,	:	That is
kg	:	Kilogram
km	:	Kilometer
qtls	:	Quintals
Rs.	:	Indian Currency called 'Rupee'
viz.,	:	Namely
X^2	:	Chi-square
%	:	Per cent
/	:	Per
Σ	:	Summation of

Introduction

CHAPTER - I

INTRODUCTION

Modernisation of agriculture implies increased use of inputs such as seeds, fertilizers, pesticides and high yielding varieties. Pesticides emerged as an important agricultural input with the advent of green revolution. Control of pests continues to be crucial for the farmers. Pesticide use has become indispensable among the farmers for maximum control in minimum possible time, which is imperative in developing countries like India.

Consumption of pesticides in India has increased by 23.9 folds from 2.35 thousand tonnes in 1950-'51 to 56.11 thousand tonnes in 1998-'99 (Department of Agriculture and Co-operation). The largest pesticides producer as well as consumer in South Asia is India. Andhra Pradesh is the largest user of pesticides in the country followed by Gujarat, Maharashtra, Punjab and Tamilnadu. Among all the states in India, the contribution of pesticides use per unit area to total is highest (18%) in Andhra Pradesh.

Pesticide externalities are inter-spatial and inter-temporal in nature. Pesticides have serious effects in terms of food contamination, reduction of export potentiality and health hazards. As a consequence, indiscriminate and excessive use of pesticides, their productivity and profitability can be reduced by accelerating the secondary pest outbreaks. To internalise the pesticide externalities at the farm level, effective implementation of the pest management technology which aimed at the reduction of pest incidence to the economic threshold level came into focus. However, technical change is not a *manna from heaven* and resources must be devoted for that and we ought to know the costs of and returns to producing new technology (Schultz 1958). The technology which integrates all the pest management strategies i.e. cultural, chemical, mechanical and biological is Integrated Pest Management (IPM) technology. Agenda 21 of the United National Conference on Environment and Development (UNCED) at Rio de Janeiro in June, 1992 identified Integrated Pest Management and control in agriculture as one of the requirements for promoting sustainable agriculture and rural development.

In the context of plant protection and preservation of environment, 26 central IPM centres have been established by merging erstwhile 43 stations (One central biological control station, 19 central surveillance stations and 13 central plant protection stations) which act as model stations for disseminating IPM technology among the state extension functionaries and farmers. An earlier beginning to transfer the IPM technology through demonstrations and training to the state extension officials has been made by these central IPM centres in rice and cotton crops. This has been done in collaboration with the state departments of agriculture.

Integrated Pest Management is a continuous process of regulating the pest (s) population (s) by one or a group of technologies based on the three pillars of ecology, economy and sociology woven in the fabric of management (Gangawar 1993). So far, in India, IPM programmes were successful in rice, cotton and groundnut crops (Lal 1996).

Problem Statement

Among the various oilseed crops grown in India, groundnut ranks first in area with 8.1 million hectares, of which 85 per cent is rainfed and only 15 per cent is irrigated producing 8 million tonnes. Though the total area and production are high, the mean productivity in India (988 Kg.ha^{-1}) is far below the world's average (1273 Kg.ha^{-1}) (F.A.O. 1999). The recognised yield reducers are insect pests which are widespread and sporadic. The annual loss caused by these insect pests in groundnut was estimated to be US $ 150 million (Ghewande *et al.,* 1987). In order to overcome insect pests, groundnut farmers often depend on insecticides. Although this approach can give satisfactory results initially, continuous and indiscriminate use of chemicals creates several problems such as insecticides resistance and secondary pest outbreaks (Armes *et al.,* 1992). Total dependence on chemicals in groundnut production causes environmental imbalance, operational hazards which in turn are followed by substantial erosion in the net incomes (Wightman *et al.,* 1994). Keeping the above problems in view, a research programme at the International Crops Research Institute for the Semi - Arid Tropics (ICRISAT) was initiated on the development of pest management strategies including need based insecticide use without sacrificing productivity and environmental quality thus enabling Integrated Pest Management technology to become popular in Guntur District.

So far, no study has been conducted in Guntur district on economic aspects, on relative resource use efficiency using IPM, on factors influencing IPM and on the examination of constraints in the adoption of IPM technology without which no policy framework could be suggested for better implementation and successful adoption. In this context, an attempt is being made to justify the following specific objectives.

Objectives

1. To study the relative resource use efficiency in groundnut production using IPM technology.
2. To analyse the factors influencing IPM technology in groundnut production.
3. To examine and identify the constraints in the adoption of IPM technology in production of groundnut.

Scope of the Study

The outcomes of the present investigation on economic aspects of IPM technology in groundnut cultivation would be useful to the farmers in assessing the enhanced productivity, profitability and other benefits derived at by adopting IPM technology. The study on awareness, adoption and constraints in adopting IPM technology would be helpful to the extension agencies to take up suitable measures to increase the rate of adoption among the cultivators. The analysis will be useful to the policy makers, in identifying the constraints faced by the farmers in adopting IPM technology and to take measures to overcome these. The studies will also be helpful to make the government agencies to supply the required inputs, that influence the technology adoption in proper time; and to know the scope for re-organisation of resources to improve the productivity and profitability. The present investigation will serve as a feed back for further research in developing appropriate location-specific technology to suit the farmers' socio-economic status.

Limitations of the Study

The study pertains to the agricultural year 1999-2000 and is limited to 120 randomly selected farmers due to paucity of time and other resources. Hence, various conclusions drawn and the explanation of various aspects of the problem have been based on the behaviour of the sample respondents and the availability of data during the reference period. The farmer respondents were not in habit of maintaining records of their income and expenditure. The entire information was provided by recall method.

Plan of the Thesis

This dissertation consists of six chapters, the details of which are as follows.

Chapter I	-	Introduction, objectives, scope and limitations of the study.
Chapter II	-	Review of past work done pertaining to the present study.
Chapter III	-	Materials and methods used in the study.
Chapter IV	-	Agro-economic features of the study area.
Chapter V	-	A critical analysis of the results and discussion.
Chapter VI	-	Summary, conclusions and policy implications.

Review of Literature

CHAPTER - II

REVIEW OF LITERATURE

A brief review of the available literature with regard to Integrated Pest Management and other objectives of the study are presented under the following heads.

2.1 Studies on Pesticide use pattern

2.2 Studies on Integrated Pest Management

2.3 Studies on Analytical tools

2.4 Major findings of the studies reviewed

2.1 STUDIES ON PESTICIDE USE PATTERN

An indiscriminate use of pesticides came into light with the spread of green revolution and gradually resulted in the recent years, in the degradation of environment and several health hazards. A review of studies on pesticide use pattern are as follows.

Chadra (1978) mentioned that the increase in the use of pesticides had been contributed by rapid changes in cropping pattern, increase in use of fertilizers and introduction of new high yielding varieties.

Rao (1979) stated that the cotton farmers were undertaking large number of sprays, sometimes as high as 15-18 sprays to have proper control. He revealed that the yields increased significantly with the reduction in the number of pesticide applications after 3-5 sprays.

Devane and Bilegaokar (1980) concluded that crop yield knowledge of factors about the damage and availability of effective control measures would increase plant protection use. Other factors like availability of easy and cheaper control measures, skilled labour, appliances and finance in time influenced the plant protection measures.

A study conducted by Narasimham *et al.* (1980) on pesticide use pattern of cotton growers in Nallapadu, Phirangipuram and Jonnalagadda villages of Guntur district, A.P. concluded that the cotton farmers were in the habit of overdosing the pesticide application even to the extent of 20-30 sprays as against 8-12, recommended by APAU.

Prabhu (1985) studied the pesticide use behaviour of cotton growers in Coimbattore district of Tamil Nadu and revealed that the decisions of cultivators on the pesticide use were based on their expectations regarding the timing and intensity of pest attack. Pest damage function, effectiveness of pesticides and furthermost, profit was an important factor in this regard.

Swaminadhan (1989) stated that the total usage of pesticides was low in the country, and usage methods were many times wrong leading to residual toxicity.

Kumar *et al.* (1993) in their study conducted at Gangavalli block of Athur taluk, Salem district found that the adoption of economic threshold levels in the application of pesticides among the farmers was too low. Their conclusions further revealed that the number of chemical sprays were 8 and 11 on small and large farms, respectively lead to the excessive use of pesticides.

Rakila and Padmanaban (1995) in their study in Coimbattore district revealed that the knowledge of the farmers on quantity of spray was higher with 62.5 per cent followed by time of spray (43.33%) and spraying technique (18.33%). It was further revealed that the major factors influencing the quantity of pesticides use were recommendations of dealer (76.67%), intensity of pests and diseases (65.83%), stage of crop growth (49.17%) and type of pests (47.5%).

Rameshchand and Pratap (1997) stated that pesticide use per unit area was the highest in Andhra Pradesh, among all the states, which alone accounted for 18 per cent of total pesticide use in the country.

2.2. STUDIES ON INTEGRATED PEST MANAGEMENT (IPM)

2.2.1 IPM Concept

Thomas *et al.* (1988) stated that the Integrated Pest Management (IPM) is a system of pest control that uses a wide spectrum of cultural, biological and chemical methods to maximise economic benefits with minimising negative environmental effects.

Kenneth and Farrell (1990) reported that the research on IPM was accelerated in 1970's with the aim to reduce synthetic pyrethroids. They stated that the alternatives to pesticides like extensive crop rotations, various sanitation practices and new pest resistance varieties have to be developed to minimise the pesticide residues.

Gangawar (1993) defined IPM as a continuous process of regulating the pest (s) by anyone or a group of (genetic, cultural, biological and / agronomical) technologies based on the three pillars of ecology, economy and sociology woven in the fabric of management.

Field demonstrations conducted by Rajak (1993) on IPM had given favourable results in terms of reduced cost of pest control and increased yield. Rajak also stated that IPM helps in reducing resistance to pesticides, residues in the soil and crop and prevents environmental imbalances, health hazards and pollution.

Khan (1996) observed that the harmful effects of pests are reduced by the IPM approach and it acts as a means to increase production levels without requiring more land, fertilizer, water or non-renewable resources. He further stated that IPM would be an indicator of the biological balance required for a cleaner earth.

Singh *et al.* (1999) opined that integrated disease and pest management not only saves lot of time, energy, but also save substantial money.

Gnanasambandan *et al.* (2000) reported that policy framework helps to reduce the reliance and availability of chemical pesticides. Pest diagnostic, monitoring tools and services are necessary for proper pest management decisions. Biotechnology and Biopesticides are in no way least bothered but, where the consumption of chemical pesticides is necessary at 3.9 per cent, annually. They opined that the technical and socio-economic impact issues are very important to address IPM policy.

2.2.2. IPM on Groundnut

2.2.2.1 Studies in India

The results of a case study of a groundnut farmer living near Bapatla, India were presented by Wightman (1994) to identify the response to an integrated management approach to groundnut pests. The farmer achieved enhanced productivity and profitability under this system. He observed the groundnut production in the study area and the tools available to the pest managers for improving yields. He examined the impact of IPM on sustainability and revealed that the prospects indicates, a positive future for its use.

Basu *et al.* (1996) reported that the level of productivity in groundnut in India is mainly influenced by the rainfall, various biotic and abiotic stresses and the socio-economic factors associated with small and marginal farmers in dryland areas. They made an attempt to alleviate the constraints by developing economically viable production and protection technologies with an emphasis on Integrated Pest Management. The use of these technologies resulted in yield advantages of 50-63 per cent.

2.2.2.2 **Studies in Abroad**

Hatcher and Wetzstein (1984) employed unrelated regression technique to evaluate IPM programme on 50 farms in Georgia State, U.S.A., during 1981-'82. This accounted for contemporaneous correlation between the distributions of related regressions for cotton, peanuts and soyabeans. They developed IPM participation indices to differentiate different types of producers. But, they felt difficulty to distinguish between users and partial users of IPM programmes. The technology as such, become more widely accepted. They found that IPM increased net returns for groundnut and soyabean producers, although there was no significant difference to cotton producers. They found, IPM was not to have decreased the level of pesticides use. They concluded that IPM was a very important input in the crop production process.

Musser *et al.* (1986) analysed 192 groundnut farmers of Georgia state, U.S.A., and explored the relationship between beliefs about IPM and its adoption. They mentioned the beliefs of users and non-users of

IPM, its influence and use, although objective data indicated that IPM technology may be more efficient than conventional pest control strategies. They observed that the educational programmes on their beliefs influenced adoption and continued use of IPM.

At the symposium on food and the environment held at the annual meeting of the American Phytopathological Society, U.S.A., in 1991, Phipps (1993) presented some of the advances in Integrated Pest Management that have had significant impact on reducing the tonnage of nematicides and fungicides used for groundnut production in Virginia State, U.S.A.

Mullen *et al.*(1997) presented a method for assessing the environmental benefits of Integrated Pest Management programme in virginia state, U.S.A. He further assessed the effects of IPM on environmental risks posed by pesticides and also estimated the society's willingness to pay to reduce those risks. They estimated the annual environmental benefits of the groundnut whose IPM programme was around $8,44,000.

2.2.3 IPM in other crops

Thomas (1986) evaluated IPM technology through large scale demonstrations at Kuttanad rice fields of Kerala and concluded that there was a substantial reduction in costs ranging from Rs. 161 to Rs. 318 per hectare, and also an increase in income ranging from Rs.100 to Rs. 1130 over 5 years of 1980-'81 to 1984-'85.

Krishnaiah *et al.* (1986) noticed during Kharif, 1985 at Kolakaluru village in Guntur District, A.P. that IPM gave additional returns of

Rs.2914 and Rs.2048 per hectare on BPH resistant and susceptible varieties, respectively besides saving Rs.478 on pest control.

Desai (1987) studied that there was an increase in rice yield from 2.5 to 3.4 t ha^{-1} as a result of implementation of Operational Research Project on IPM at Rajanal canal area of Raigadh district in Maharashtra during 1979-'85.

Qadeer and Ranveersingh (1993) reported that in paddy, the expenditure on non-IPM plots was 58.2 per cent higher than IPM plots in Haryana. They also observed an increase in grain yield by 3.3 per cent.

Rao *et al.* (1993) noticed that even if yields were higher in chemical control plots, the cost-benefit ratio was in favour of IPM plot i.e. 1:5.3 while it was only 1:2.5 in the intensive chemical treated plots.

Patel *et al.*(1996) conducted trial on IPM in paddy at Paddy Research Station, NARP, Navrasi from 1988-'89 to 1989-'91. The results indicated that the resistant culture (IET - 9813) with wider spacing coupled with need based plant protection measures registered the highest grain yield of 4724 Kg ha^{-1}, the highest net returns of Rs.3608 ha^{-1} and the highest cost-benefit ratio of 1:2.19 in the same treatment.

Tanweer and Rao (1997) in their study conducted at Pulladigunta village of Guntur district of Andhra Pradesh, evaluated chemical control, IPM approach and farmer's practice and indicated that scientific and Judicious use of chemical pesticides with a cost-benefit ratio of 1:1.77 was the best method of plant protection from yield economics point of view and the next best treatment was IPM with a cost-benefit ratio of

1:1.50 from the ecological and environmental protection point of view at global level. This was also economically viable.

Chowdry and Seetharaman (1997) in their study in Guntur district revealed from the on farm trials that there was a reduction in the expenditure on plant protection of cotton which accounted for 22.68 per cent of operational costs in farmers method to 13.34 per cent in IPM technology. The benefit-cost ratios were 0.49 and 0.79 in traditional practice and IPM, respectively. They concluded that IPM technology was found to be economically viable both at research station and at farmer's fields and helped in reducing the costs on pesticides and fertilizers.

2.3 STUDIES ON ANALYTICAL TOOLS

2.3.1 Production function analysis

The log-log production function is used for estimating the resource use efficiency of any product in the production process. A review of studies on production function analysis are mentioned below.

Cobb-Douglas production function was employed by Mishra (1971) to study the resource use efficiency in paddy farms of fertilizer users and non-users. The comparison of marginal value products with their marginal costs surfaced that there was not much difference in the efficiency of resources between users and non-users.

Satpute and Bhole (1974) applied double-log production function for the cotton and found increasing returns to scale. Marginal returns to labour was much greater than the marginal cost which indicated the scope for rising output profitably by increasing the use of labour. The marginal returns to manures and fertilizers were also greater than marginal costs.

Singh (1975) fitted Multiplicative production function and confirmed the hypothesis of constant returns to scale in the selected region in both small and large farms, through the study on 'Resource - Use, farm size and returns to scale in backward agriculture'. The marginal productivity of labour was found to be quite high on large farms but very low on small farms.

Sankhayan (1978) reported that there existed an inverse relation between the size of holding and productivity. Further, he pointed out that higher productivity on small farms could only be attributed to better and intensive care that the owners of these farms afforded to pay to their business as compared to large farms.

Carlisle (1981) observed that increasing returns to scale existed both on small and large farms. Productivity of land and capital were higher on small farms than on large farms. Among the variables considered, the productivity of land was higher followed by capital both on small and large farms.

Alshi *et al.* (1983) indicated constant returns to scale in the case of hybrid, desi and American cottons. The variables, fertilizers, farm yard manure and capital indicated that 72 per cent variation in the case of desi cotton, 80 and 94 per cent in the case of American cotton and hybrid cotton, respectively.

Haque (1985) revealed the relative role of different factors in determining the rice yields by fitting Cobb - Douglas equation. The results of the regression equation showed that the proportion of rice area irrigated coupled with area under high yielding varieties and the consumption of chemical fertilizers were the most significant determinants.

Prasad *et al.* (1988) used Cobb-Douglas production function for estimating resource use efficiency and found that the marginal value product for pesticides and fertilizers were significantly lower than the opportunity cost. They concluded that the excessive use of these two inputs in cotton farms resulted in the lowering of marginal value products.

Jayaram *et al.* (1992) found that farmers were operating at constant returns to scale as indicated by the sum of the regression coefficients not being significantly different from unity. The regression coefficients for seeds, plant protection chemicals and labour were found to be significant in the case of large farmers while for small farmers, the coefficients for farm yard manure, nitrogen and labour were significant.

Mahita and Hemachandrudu (1992) employed Cobb-Douglas production function. It revealed that all the resources in paddy cultivation in Andhra Pradesh state were used excessively, resulting in low efficiency and high cost. They inferred that, there was a high degree of resource use inefficiency on paddy farms in A.P. and there is a need for reorganisation of farm resources.

Sunandini *et al.* (1993) studied resource productivity and resource use efficiency of paddy farms of A.P. and found that resource elasticities in different combinations used in all the regions of A.P. indicated diminishing marginal returns. They reported that there was a wide scope for higher profits by increasing the use of tractors, manures and fertilizers.

In the present study, multiplicative production function is being used to study the relative resource use efficiency using IPM technology.

2.3.2 Decomposition Analysis

This is used for any production function, wherein the total change in the dependent variable is produced by change in the factors of production and in the parameters that define the function. A review of studies on decomposition analysis are mentioned as below:

Bisaliah (1977) by employing decomposition analysis, decomposed the total change in per acre wheat output (40.20%) with the introduction of new technology into the proportion due to technical change (15%) and the proportion due to input change (25.50%). The analysis revealed that the per acre wheat production with Mexican Variety i.e. new technology was about 40 per cent higher than that with local variety. It was estimated that the value of inputs saved with the new technology was Rs.67 per acre. He further estimated, the quantity of extra output obtained with new technology using the old technology volume of inputs as 61 Kg. per acre.

Hill (1984) used decomposition analysis and revealed that variable factor supply limitations may be significant constraints to production expansion in rice production in the Dominion Republic.

Kuroda (1988) examined quantitatively the importance of the biased effects for determining changes in factor-cost shares and factor proportions during the 1958-'84 period and found significant.

Abedin and Bose (1988) classified the factors contributing to productivity variations into neutral technological differences, non-neutral technological differences and input use contribution and concluded that as far as modern rice production was concerned, there exists a positive relationship between farm size and productivity. Further, neutral technology was in favour of small and medium farms compared to large farms.

Arya and Rawat (1990) determined the influence of number of milking animals (NM), their productivity (YM), and price of milk (PM) on growth of milk production in Haryana state. The results indicated that PM had the greatest influence (29.59%) on production of cow milk followed by YM x PM interaction (25.18%) and YM (18.77%). Buffalo milk production was influenced to the greatest extent by PM (36.33%) followed by NM x PM interaction (23.61%) and NM (17.3%).

Cauvery (1991) employed decomposition analysis by using a revised 7- factor model taken into account, cropping patterns and its interaction with yields and acreage to examine groundnut cultivation. The analysis indicated that the increase in groundnut supply has been the result of greater area under cultivation as opposed to higher productivity as a consequence of modern technology. It was concluded that there is still some potential for developing techniques to raise the productivity of groundnuts in India.

Mitra and Jena (1991) evaluated the growth rates achieved by groundnut producers by decomposing into area, production and productivity when compared to population growth rates in Orissa. It was concluded that an increase in area under cultivation alone will fail to attain the required levels of production, giving rise to the need for higher yields by using better farm inputs.

Shui *et al.* (1993) found that technical change decreased natural fibre use in U.S. textile mills in favour of man-made fibres. It was concluded that non-price factors accounted for 70 per cent of the decline in long-run natural fibre use.

Kiresur *et al.* (1995) examined the nature of technological changes in sorghum. The analysis revealed that the total difference in the productivity per hectare between modern and traditional varietal technologies of sorghum was estimated to be about 45 per cent. The major component of this productivity gap was the difference in varietal technology which contributed nearly 35 per cent. They concluded that the remaining 10 per cent was shared by differences in input use between the modern and traditional sorghum production technologies.

Huang and Rozele (1996) used growth decomposition analysis and identified that technology adoption was the most important determinant of rice yield growth from 1978-'84. It accounted for nearly 40 per cent of the change. Further, institutional reform accounted for 35 per cent of the growth. It was concluded that during 1985-'90, technology accounted for all increases in rice yields.

Wier and Hasler (1999) examined the environmental-economic cycle for nitrogen in Denmark. They decomposed the changes in agricultural and industrial nitrogen into changes related to different technological and economic factors. The analysis revealed that technological change (intensified agricultural production) and economic growth (especially rising exports) were the key factors for the changes in agricultural and industrial nitrogen. It was concluded that structural shifts (changes in commodity mix in the household and production sectors) were of less importance.

In the present investigation, decomposition analysis is being used to analyse the factors influencing IPM technology in groundnut production.

2.3.3. **Indices**

Technology and adoption indices are used to analyse the varying levels of adoption. A brief review of studies on indices are summarized as follows.

Rao and Prasad (1994) in an economic analysis of on-farm trials under different farming situations and applied technology index stated that the level of adoption of technology by the redgram cultivators was only 46 per cent in red sandy loams under rainfed conditions. It was suggested that more attention should be paid by the extension agency in popularising the technology in order to reap higher profits.

Prasad *et al.* (1996) on Economics and adoption pattern of different crops in a watershed area of Andhra Pradesh, by using technology index concluded that the level of adoption of technology was higher in groundnut followed by maize and greengram. They employed adoption index and found that the adoption pattern of the respondents was not at all satisfactory. They recommended that suitable measures should be taken to increase the index so as to improve the socio-economic conditions of the farming community.

In this study, technology and adoption indices are being used to analyse the varying levels of adoption.

2.3.4 Friedman's test

This is used to know the significant differences among the constraints. A review of studies on Friedman's test are mentioned below.

Abuodeh and Scalarone (1995) by using Friedman's test, analysed the induction and detection of delayed dermal hypersensitivity in guinea-pigs immunized with Blastomyces dermatitidis lysate and filtrate antigens. Results indicate that a significant difference between them and the precision was less than 0.05.

Prasad *et al.* (1996) in their study on Economics and adoption pattern of different crops in a watershed area of Andhra Pradesh, by using Friedman's test revealed that significant differences among the 15 constraints under each of three crops viz., Maize, Greengram and Groundnut were found in adoption of technology.

Caser *et al.* (1998) from Agricultural Regional Division, presented the annual data and analysed the forest vegetation cover of Sao Paulo state, Brazil for the period from 1970 to 1995. They employed Friedman's rank test and determined that the Agricultural research divisions were similar in area occupied by each forest type. Areas of eucalyptus and short savanna were also found to be similar.

Snyder *et al.* (1998) performed Friedman's test, cluster analysis, cross-correlation analysis and Duncan's test to know the impact of riparian forest buffers on agricultural nonpoint source pollution. It was concluded that the riparian buffer zone was effective in reducing nitrate concentrations originating from upland agricultural fields.

In this study, Friedman's test is being used to know the significant differences among the identified constraints.

2.4 MAJOR FINDINGS OF THE STUDIES REVIEWED

The main findings of various studies reviewed in this chapter are summarised and presented here under.

Pesticide use pattern indicated that the indiscriminate use of pesticides was due to increase in the fertilizer application, introduction of new high yielding varieties and profit motive.

Integrated Pest Management (IPM) in groundnut and other crops resulted in terms of reduced cost of pest control. Its harmful effects, increased yield and Benefit-cost ratios were higher in case of IPM than that of non-IPM adopted farms. Difficulty was experienced in distinguishing users and partial users of IPM and net returns were increased due to IPM in groundnut. Educational programmes on the beliefs of farmers influenced the adoption and continued use of IPM. Enhanced productivity and profitability were achieved with IPM technology in turn.

Resource use efficiency for different crops was estimated by using Cobb - Douglas production function. It was found that a significant difference does exist among the factors.

Factors influencing the new technology in different crops were estimated by employing decomposition analysis. It was found that per acre output with new technology was higher than that of old technology. Contrary to this Cauvery (1991) employed a seven factor decomposition model and found that the increase in groundnut supply was due to greater area under cultivation as opposed to higher productivity as a consequence of modern technology.

The level of adoption of technology was examined by using technology and adoption indices. The constraints and factors responsible for adoption of technology were identified by using Friedman's test. Significant differences were noted in all the studies cited except caser *et al.* (1998).

Materials & Methods

CHAPTER - III

MATERIALS AND METHODS

In this chapter the detailed sampling procedure for selection of the district, mandals, villages and farmers, the sources and mode of collection of data, concepts and terms used, various analytical tools both statistical and functional models employed in achieving the objectives are discussed. The chapter is divided into the following heads.

3.1 Sampling procedure

3.2 Methods of enquiry and collection of data

3.3 Terms and Concepts

3.4 Tools of analysis

3.1 SAMPLING PROCEDURE

The sampling procedure followed for the present study, in order to select the respondents has been discussed in the following heads

3.1.1. Selection of the District

Guntur district in Andhra Pradesh was selected purposively for the study, as Integrated Pest Management technology was implemented during 1992-'94 covering two seasons by ICRISAT and ANGRAU.

3.1.2 Selection of Mandals

Two mandals in Guntur district viz., Karlapalem and Cherukupalli were purposively selected as IPM technology was demonstrated in three villages of Karlapalem and one village of Cherukupalli mandal.

The groundnut cultivated area in Guntur district was 6177.60 hectares and in Karlapalem and Cherukupalli mandals, it was 1030 and 193.60 hectares, respectively (Table 3.1).

3.1.3 Selection of the Villages

Three villages viz., Karlapalem, Ganapavaram and Nakkalavaripalem from Karlapalem mandal and one village viz., Kavur from Cherukupalli mandal were purposively selected because of the implementation of IPM technology in these four villages. Two non-IPM adopted villages viz., Chintayapalem and Ponnapalli situated 6-20 kms away from the IPM adopted villages were selected randomly, from the mandals of Karlapalem and Cherukupalli respectively.

3.1.4 Selection of Respondents

Sample farmers were selected by using proportionate random sampling technique.

3.1.4.1 Selection of IPM adopters

To choose the cultivators from selected IPM villages, percentage of groundnut cultivated area to the total of four villages has been worked out and the total number of groundnut cultivated farmers were identified for each of four villages. The respondents were selected randomly from the total number of groundnut farmers in proportion to the computed percentages for each of four villages viz., Karlapalem (22), Ganapavaram (35), Nakkalavaripalem (15) and Kavur (8). Thus, the total number of IPM adopters constitute 80. (Table 3.2)

3.1.4.2 Selection of non-IPM Adopters

The respondents were selected from two non-IPM villages pro rata to the percentage of groundnut cultivated area of each village. The

Table 3.1 : Area under groundnut in Guntur district and selected mandals

S No	Particulars	Area (ha)
1	Guntur District	6,177.60
2	Karlapalem	1,030.00
3	Cherukupalli	193.60

Source : Chief Planning Office , Guntur

Table 3.2 : Area under groundnut in the selected villages along with number of respondents

S.No.	Particulars	Area (ha)	No. of farmers	% to total
A.	IPM technology adopted Villages	442.0	80	100
1	Karlapalem	118.8	22	27
2	Ganapavaram	190.0	35	43
3	Nakkalavaripalem	84.0	15	19
4	Kavur	49.2	8	11
B.	Non – IPM technology adopted villages	137.2	40	100
1	Chintayapalem	98.0	29	72
2	Ponnapalli	39.2	11	28

Source : Mandal Revenue Office , Karlapalem.

Mandal Revenue Office , Cherukupalli.

sample number of farmers were chosen by using these percentages from each of the two villages viz., Chintayapalem (29) and Ponnapalli (11). In this way, a sample of 40 farmers were selected. (Table 3.2)

3.2 METHODS OF ENQUIRY AND COLLECTION OF DATA

The primary data on socio-economic aspects, costs and returns of cultivation and also the opinion on the constraints in adoption of IPM technology pertaining to groundnut crop were collected through survey method by personally interviewing the sample farmers, using pre-tested and well-structured schedules. The secondary data related to Agro-economic aspects of the study area were collected from Chief Planning Office and mandal offices of Guntur district. The data pertains to the agricultural year 1999-2000.

3.3 CONCEPTS OR TERMS USED IN THE STUDY

Expenditure on Human Labour

The labour input is measured in terms of man days and women days and the expenditure on human labour is computed by taking the current wage rates prevailing in the village.

Expenditure on Traction Power

The costs of bullock power and tractor power are included and computed by taking the prevailing market prices in the village situation. The cost of engine oil consumed for irrigating groundnut is also included.

Expenditure on Seeds

It is the expenditure incurred by the farmer on groundnut seeds.

Expenditure on Manures

The quantity of Farm Yard Manure (FYM) and Castor cake used in the groundnut cultivation are measured in terms of cartloads and truckloads. The costs are computed by taking the actual market price prevailing in the village.

Expenditure on Fertilizers

The expenditure on fertilizers in groundnut cultivation is computed by taking the prices paid by the farmers.

Expenditure on Plant Protection Technology

This includes the following items:

1. Labour cost on more number of ploughings than the recommended number.
2. Labour cost on additional number of intercultivations i.e. weedings than the recommended number.
3. Material and labour cost on fungicides and pesticides.
4. Material and labour cost on IPM technologies in groundnut.

IPM (Integrated Pest Management)

It is defined as a system of pest control that uses a wide spectrum of cultural, biological, mechanical and chemical methods to maximise economic benefits while minimising negative environmental effects.

IPM technologies on groundnut*

1. Clean cultivation and summer ploughing.
2. Trap cropping with sunflower/castor @ one plant for every 2m in a row and with one such row/4rows.

3. Use of pheromone traps @ 2-4 per acre for regular monitoring of the pest.

4. One application of neem kernel extract spray after the appearance of egg masses and first instar larvae in the field.

5. Manual collection and destruction of larvae and egg masses at 4-5 day intervals after the appearance of moths in the phero- mone traps, on sunflower or castor trap plants and also in the main field.

6. Application of fungicide i.e. chlorothalonil.

7. Application of NPV (Nuclear Polyhedrosis Virus) for *Spodoptera* sp. control @ 200 Larval equivalents/acre twice during evening times synchronising with the appearance of good number of early instar larvae.

   *Source : ICRISAT and ANGRAU

Economic Threshold Level (ETL)

It is that level of pest infestation to which application of a control measure would result in more income than the cost of the control measure.

Total Cost of Cultivation

The cost of human labour, traction power, seeds, manures, fertilizers and plant protection technologies are included

3.4 TOOLS OF ANALYSIS

3.4.1 Tabular Analysis

Tabular analysis was used to compute sample means and percentages to study the general characteristics of sample respondents, costs, returns and Benefit-Cost ratios of groundnut cultivation.

3.4.1.1 **Returns**

Gross income = Value of total output

i.e.Main product + By product.

Net income = Gross income - Total costs.

$$\text{Benefit-Cost ratio} = \frac{\text{Net income}}{\text{Total cost of cultivation}}$$

3.4.2 **Statistical Tools**

Production function gives us the maximum quantities of production that can be obtained by the transformation of different combinations of inputs. The important forms of production functions used to cross-sectional data for empirical estimation are Cobb-Douglas, Multiple Linear Regression, Translog production function and Constant Elasticity of Substitution.

In this study, log-linear multiplicative regression function is obviously the convenient function for testing the quality of parameters governing the input-output relationship and for decomposing the total change in the dependent variable. To find out the significant differences among the constraints, Friedman's test is appropriate as the constraints are subject to critical examination and identification. To know the varying levels of adoption of a practice, suitable indices are Technology Index and Adoption Index.

Because of the small size holdings of the respondents, per acre estimates were taken for the statistical analysis.

3.4.2.1 Production function analysis

Functional analysis is the technical and functional relationship that exists between input and output. This was carried out to examine the contribution of each identified factor to the gross returns. In this study, Cobb-Douglas production function was used to study the relationship between gross returns per acre and six specified variables. Resource returns, returns to scale and resource use efficiency were estimated by employing the Cobb-Douglas production function. This production function has been selected due to its advantages over other production functions and for easy computational procedure.

The general form of this function is as follows:

$$Y = a \prod_{i=1}^{k} X_i^{b_i} e_i^{u_t}$$

where,

Y = Gross income (Rs.)

X_1 to X_k = Independent variables considered in production (k=6)

b_1 to b_k = Production elasticities of factors X_1 to X_k

a = Intercept

e_i = Error term

In the present study, this function was fitted in log form with gross income (Y) as dependent variable and X_1 to X_6 inputs as explanatory variables.

This function in log form would be:

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u_1$$

where,

Y = Gross income (Rs.)

X_1 = Expenditure on human labour (Rs.)

X_2 = Expenditure on traction power (Rs.)

X_3 = Expenditure on seeds (Rs.)

X_4 = Expenditure on manures (Rs.)

X_5 = Expenditure on fertilizers (Rs.)

X_6 = Expenditure on plant protection technology (Rs.)

a = Intercept

b_1 to b_6 = Production elasticities of factors X_1 to X_6

u_t = Error term

Production elasticities or Regression coefficients

For testing the regression coefficients of production elasticities, 't' value was calculated using the formula

$$t = b_i \ / \ SE \text{ of } b_i$$

where,

b_i = Regression coefficient or production elasticity of input X_i

SE of b_i = Standard error of b_i

i = 1 to k

Returns to Scale

The sum of regression coefficients or production elasticities of all the inputs (Σb_i) indicates the nature of returns to scale.

If, Σb_i = 1 constant returns to scale

$>$ 1 Increasing returns to scale

$<$ 1 Decreasing returns to scale

R^2 was calculated by using the following formula

$$R^2 = \frac{\text{Regression sum of squares (R.S.S.)}}{\text{Total sum of squares (T.S.S)}}$$

R^2 = Coefficient of multiple determination

$$\text{where R.S.S.} = \Sigma[bi\{\Sigma(\log xi)\ (\log y) - \frac{\Sigma(\log xi)\ \Sigma\ (\log y)\}}{n}]$$

$$\text{T.S.S.} = \Sigma(\log y^2) - \frac{\Sigma\ (\log\ y)^2}{n}$$

n = Sample size

Multicollinearity was not found among the variables included in the production function as observed from the zero order correlation matrix.

3.4.2.2 **Decomposition analysis**

This is applied to the production function wherein the total change in the dependent variable is produced by change in the factors of production and in the parameters that define the function.

In order to analyse the factors influencing IPM technology and their contribution, by decomposing the total change in per acre groundnut income with the introduction of IPM technology into the proportion due to technical change and the proportion due to the input change, the decomposition model proposed by Bisaliah (1977) was used.

Besides decomposing the total change, value of inputs saved with IPM technology and the value of extra output obtained were also estimated. The empirical model is derived as follows.

$$\text{Log } Y_1 = \log A_1 + a_1 \log H_1 + b_1 \log L_1 + c_1 \log S_1 + d_1 \log M_1 + e_1 \log F_1 + f_1 \log P_1 + u_1 \text{ ....(1)}$$

$$\text{Log } Y_2 = \log A_2 + a_2 \log H_2 + b_2 \log L_2 + c_2 \log S_2 + d_2 \log M_2 + e_2 \log F_2 + f_2 \log P_2 + u_2 \quad \text{.................(2)}$$

Equations (1) and (2) are the Cobb - Douglas per acre production functions in logarithmic form for non-IPM and IPM technology adopted groundnut farms, respectively.

Where, Y = Gross income (Rs)

H_1 = Expenditure on human labour (Rs)

L_1 = Expenditure on traction power (Rs)

S_1 = Expenditure on seeds (Rs)

M_1 = Expenditure on manures (Rs)

F_1 = Expenditure on fertilizers (Rs)

P_1 = Expenditure on plant protection technology (Rs)

A_1 is the scale parameter and a_1, b_1, c_1, d_1, e_1, f_1 denote output elasticities of the respective inputs; u_1 is a random disturbance term, independently distributed with zero mean and finite variance.

Definitions of variables and parameters in equation (2) are the same as in equation (1).

Taking differences between equations (2) and (1) and adding some terms and subtracting the same terms and rearranging them, the equation could be written as:

$$\text{Log } \frac{Y_2}{Y_1} = \log \left(\frac{A_2}{A_1}\right) + [(a_2-a_1) \log H_1 + (b_2-b_1) \log L_1 + (c_2-c_1) \log S_1 + (d_2-d_1) \log M_1 + (e_2-e_1) \log F_1 + (f_2-f_1) \log P_1] + [a_2 \log \left(\frac{H_2}{H_1}\right) + b_2 \log \left(\frac{L_2}{L_1}\right) + c_2 \log \left(\frac{S_2}{S_1}\right) + d_2 \log \left(\frac{M_2}{M_1}\right) + e_2 \log \left(\frac{F_2}{F_1}\right)$$

$$+ f_2 \log \left(\frac{P_2}{P_1}\right)] + (u_2 - u_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The contribution of technical change to total change in income is obtained by adding the values of the first and second bracketed expressions on the right hand side of equation (3), whereas the first and second bracketed expressions are the measure of percentage changes in the income due to shifts in scale parameter and slope parameters, respectively. The third bracketed expression is a measure of change in income due to changes in the per acre quantities of inputs used, given the output elasticities of these inputs under IPM technology. These three expressions together account for the total change in income.

3.4.2.2.1 **Value of inputs saved approach**

With the value of inputs saved approach, the resources required to produce per acre IPM technology level of income by non-IPM technology are estimated. The difference between this figure and the resources actually used to produce the IPM technology level of income represents the value of inputs saved because of the higher level of efficiency due to IPM technology.

The following expression was being formulated to estimate the value of inputs saved due to IPM technology:

$$R_{oT} = \left(1 + \frac{r}{100}\right) R_{NT}$$

$$S_R = \left(\frac{r}{100}\right) R_{NT}$$

3.4.2.2.2 **Value of extra output obtained approach**

The value of extra output obtained with IPM technology, using the non-IPM technology volume of inputs was being estimated by using the following formula.

ΔY	=	$Y_{NT} - Y_{OT}$
(ΔY) (r)	=	Value of extra output due to technical change alone.
Where, Y_{NT}	=	Per acre income with IPM technology
Y_{OT}	=	Per acre income with non-IPM technology
R_{NT}	=	Value of human labour, traction power, seeds, manures, fertilizers and plant protection technology used in producing Y_{NT}.
R_{OT}	=	Value of selected individual inputs required to produce Y_{NT} with non-IPM technology.
r	=	Percentage increase in income per acre under IPM technology with the non-IPM technology volume of all selected exogenous variables per acre.
S_R	=	Value of per acre selected individual explanatory variables saved to produce Y_{NT} with IPM technology.

3.4.3 Non-parametric test

To find out significant differences between the constraints in the adoption of a practice, Friedman's test is applied. To analyse the varying levels of adoption of a practice, the indices generally used are technology index and adoption index.

3.4.3.1 **Friedman's test**

To examine and identify the constraints in the adoption of IPM technology in groundnut production, a non-parametric statistic i.e. Friedman's test was used.

In Friedman's test, the perception of farmers on the constraints that are being encountered in adopting IPM technology were collected in the form of scores and grouped into social, economic and feasibility of implementation constraints. The scores then, were ranked and tested. The test statistic is as follows:

$$X^2\,(F) = \frac{12}{nk\ (k+1)} \sum_{j=1}^{k} R_j^2 - 3n(k+1)$$

Where,

x^2 (F) = Friedman's test

n = Number of IPM technologies developed on groundnut.

k = Number of constraints on groundnut

Rj = Total of ranks in the jth column for j=1 to k.

Adjustment Friedman's test is used as ties took place in ranking of constraints.

$$X^2F(adj) = \frac{X^2(F)}{1 - \dfrac{\Sigma t^3 - \Sigma t}{nk(K^2-1)}}$$

Where, t = Number of ties among ranks.

3.4.3.2 **Technology and Adoption Indices**

To analyse the varying levels of adoption, the following indices were computed.

$$\text{Technology Index (T.I)} = \frac{Y^0 - Y}{Y^0} \times 100$$

Where,

Y^0 = potential yield

Y = Actual yield

$$\text{Adoption Index (A.I)} = \frac{a}{p} \times 100$$

Where, a = Adoption score obtained by IPM respondents

p = Possible maximum score

The lower the value of T.I the higher will be the value of A.I. This implies a higher level of adoption of technology.

Agro-Economic Features

CHAPTER - IV

AGRO-ECONOMIC FEATURES

The Successful implementation of any technology on a crop depends not only on the physical environment but also on agro-climatic conditions of the region, where the crop is grown. The adoption pattern of technology, therefore differs from region to region. Hence, a brief description about the study area is presented below to have a better understanding about the region.

4.1 GUNTUR DISTRICT

Guntur district is divided into three revenue divisions with 57 mandals having a total geographical area of 10,76,251.20 hectares. There are 728 revenue villages and 729 villages in the district. On the north, Krishna and Nalgonda districts, on the west Mahaboobnagar and Prakasam, on the east Krishna district and Bay of Bengal are situated. It is situated between 15°18' and 16°41' northern latitude and 70°10' and 80°55' Eastern longitude.

4.1.1 Demographic Particulars

Demographic patterns in the district are presented in Table 4.1. The total population of this district as per 1991 census is 41,06,999. It is observed that the rural population is 29,20,299 and it is more than double to that of urban population of 11,86,700. The density of population per square kilometer was found to be 361. There are 970 females per thousand males in the district.

4.1.2 Literacy Status

Literacy rate of the district is 92.39 per cent. Male literates are 10,03,130 (48.12%) and female literates are 6,17,234 (30.52%). In rural

Fig:4.1 MAP OF GUNTUR DISTRICT.

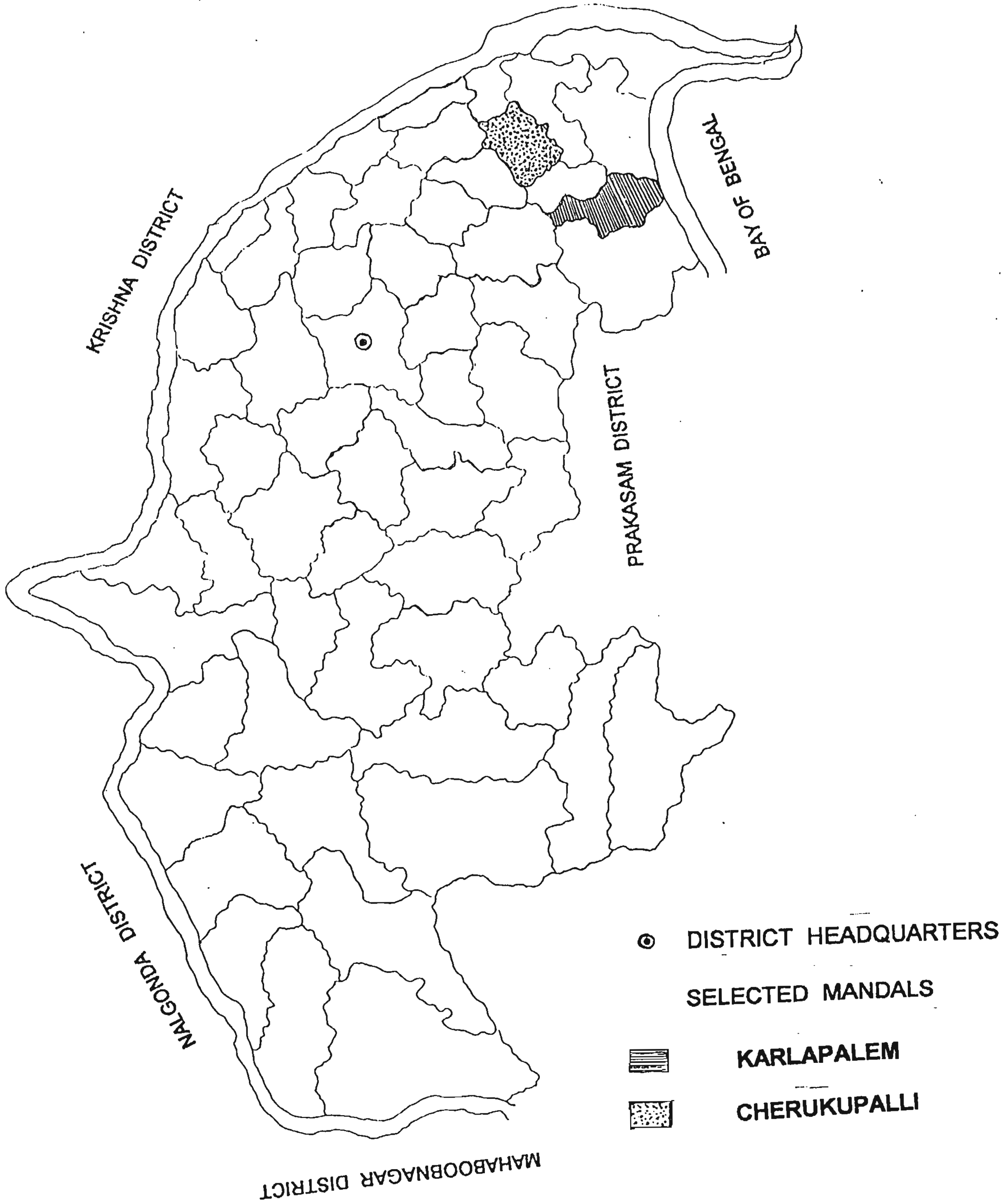


Table 4.1 : Demographic features of Guntur district (1991)

Particulars	Population in 1991	% to total
Males	20,84,480	50.75
Females	20,22,519	49.25
Rural	29,20,299	71.11
Urban	11,86,700	28.89
Total	41,06,999	100.00
Density / Sq. Km.	361	-
Females / 1000 Males	970	-

Source : Chief Planning Office , Guntur.

Table 4.2 : Literacy status of Guntur district (1991)

Particulars	Actual population	No. of literates	% of literacy
Male	20,84,480	10,03,130	48.12
Female	20,22,519	6,17,234	30.52
Rural			
Male	14,84,213	6,39,607	43.09
Female	14,36,086	3,56,504	24.82
Urban			
Male	6,00,267	3,63,523	60.56
Female	5,86,433	2,60,730	44.46

Source : Deputy Director of Planning and statistics , Guntur population, 43.09 per cent of males and 24.82 per cent of females are literates. The per cent of male and female literates in Urban area are 60.56 and 44.46, respectively (Table 4.2).

4.1.3 Climate and Rainfall

The climate is generally very warm and the temperature is very high on the upland tract. During the Agricultural year 1998-1999 the total rainfall received was 745.7 mm which is slightly lower than the normal rainfall (778.8 mm) and the total number of rainy days were 50. The least rainfall was received from winter showers (5.3 mm). The major portion of the rainfall is received from South-West and North-East Monsoons (Table 4.3)

4.1.4 Soils

Guntur district has three types of soils viz., sandy soils (6%), Red loamy soils (24%) and Black soils (70%). It is clear that most of the soils are black cotton soils in the district.

4.1.5 Irrigation

Guntur district gets water from Krishna Delta system for irrigation. In uplands, rainfall is supplemented by flow irrigation from tanks and lift irrigation from river banks. In the coastal belt, the soils are sandy and the level of water table will be very high i.e., 2-3' in winter and 4-6' in summer below the surface. The vast stretch of sands in the coastal belt has a peculiar system of irrigation through splash watering. The details of sources of irrigation in Guntur district are given in Table 4.4.

4.1.6 Land Utilisation

Analysis of land use in any area is very important as it gives a wide picture of land use, available fallows, net area sown and

Table 4.3 : Rainfall pattern of Guntur district (1998 – '99)

Monsoon	Normal rainfall (mm)	Amount of rainfall (mm)	No.of rainy days
South – West Monsoons	503.4	525.9	33
South – East Monsoons	199.8	170.3	12
Winter showers	6.6	5.3	2
Summer showers	69.0	44.2	3
Total	778.8	745.7	50

Source : Joint Director of Agriculture Office , Guntur

Table 4.4 : Source of irrigation in Guntur district (1998 – '99)

S.No.	Irrigation source	Area irrigated (ha)
1	Krishna – Western delta	1,74,118.4
2	Guntur channel	8,420.4
3	Nagarjuna Sagar right canal	1,45,904.0
4	Others	3,92,318.0
	Total	7,20,760.8

Source : Chief Planning Office , Guntur.

Table 4.5 : Land utilisation pattern in Guntur district (1998 – '99)

S No	Particulars	Area(ha)	% to total area
1	Forest	1,54,342.40	14.34
2	Barren and uncultivable lands	4062.00	0.38
3	Land put to non-agricultural use	1,45,486.00	13.52
4	Permanent pastures and other grazing lands	23,895.20	2.22
5	Land under miscellaneous trees	40,616.80	3.77
6	Cultivable waste	39,579.20	3.67
7	Other fallow lands	20,843.20	1.94
8	Current fallow lands	18,686.00	1.74
9	Net area sown	6,28,740.40	58.42
10	Total geographical area	10,76,251.20	100.00

Source : Hand book of statistics, Guntur district, 1999.

consequent economics contributing to the economic growth of the zone. The land utilisation pattern in Guntur district is furnished in Table 4.5.

4.1.7 Cropping Pattern

This gives an idea of the crops grown in the study area (Table 4.6). It is clear from the table that among the various food crops grown, rice occupies prime place.

4.1.8 Live-stock Population

The total live-stock population in the district stands at 42,68,008 as per 1993-'94 live-stock census. Table 4.7 reveals that poultry occupy 67.05 per cent followed by buffaloes (19.44%) to the total population.

4.2 AGRO-ECONOMIC FRAME WORK OF STUDY AREA

The two mandals selected for the study are Karlapalem and Cherukupalli. Four villages viz., Karlapalem, Ganapavaram, Nakkalavari-palem and Chintayapalem were selected from the Karlapalem mandal. Two villages selected from Cherukupalli mandal were Kavur and Ponnapalli.

4.2.1 Karlapalem

The mandal is surrounded by Ponnur, Bapatla, P.V. Palem and Nizampatnam mandals with a total geographical area of 10,124.4 hectares. The total population of the mandal as per 1991 census is 59,236. There are 984 females for every 1000 males. Net area sown during 1998-1999 is 7,359.2 hectares.

4.2.1.1 Chintayapalem village

The total population of the village is 2,234 which comprises 1,132 males and 1,102 females. The literates constitute 30.17 per cent of the population. The net area sown annually is 894.65 hectares.

Table 4.6 : Abstract of the main crops grown in Guntur district (1998 – '99)

S No.	Crop	Area (ha)
1	Rice	3,23,732.80
2	Maize	5046.40
3	Redgram	27,028.00
4	Greengram	16,285.60
5	Blackgram	1,29,483.60
6	Groundnut	6,177.60
7	Sesamum	7,760.80
8	Castor	1,388.40
9	Chilli	36,452.80
10	Cotton	1,91,341.20
11	Sugarcane	3,865.20
12	Turmeric	4,094.00
13	Total vegetables	14,580.00
14	Others	93,469.20
	Total	8,60,705.60

Source : Handbook of statistics , Guntur district 1999

Table 4.7 : Live – stock population in Guntur district

Particulars	Population	% to total
Cattle	1,40,910	3.3
Buffaloes	8,29,629	19.44
Sheep	2,70,429	6.34
Goat	1,09,418	2.56
Pig	55,978	1.31
Poultry	28,61,644	67.05

Source : Chief Planning Office , Guntur.

4.2. MAP OF KARLAPALEM MANDAL

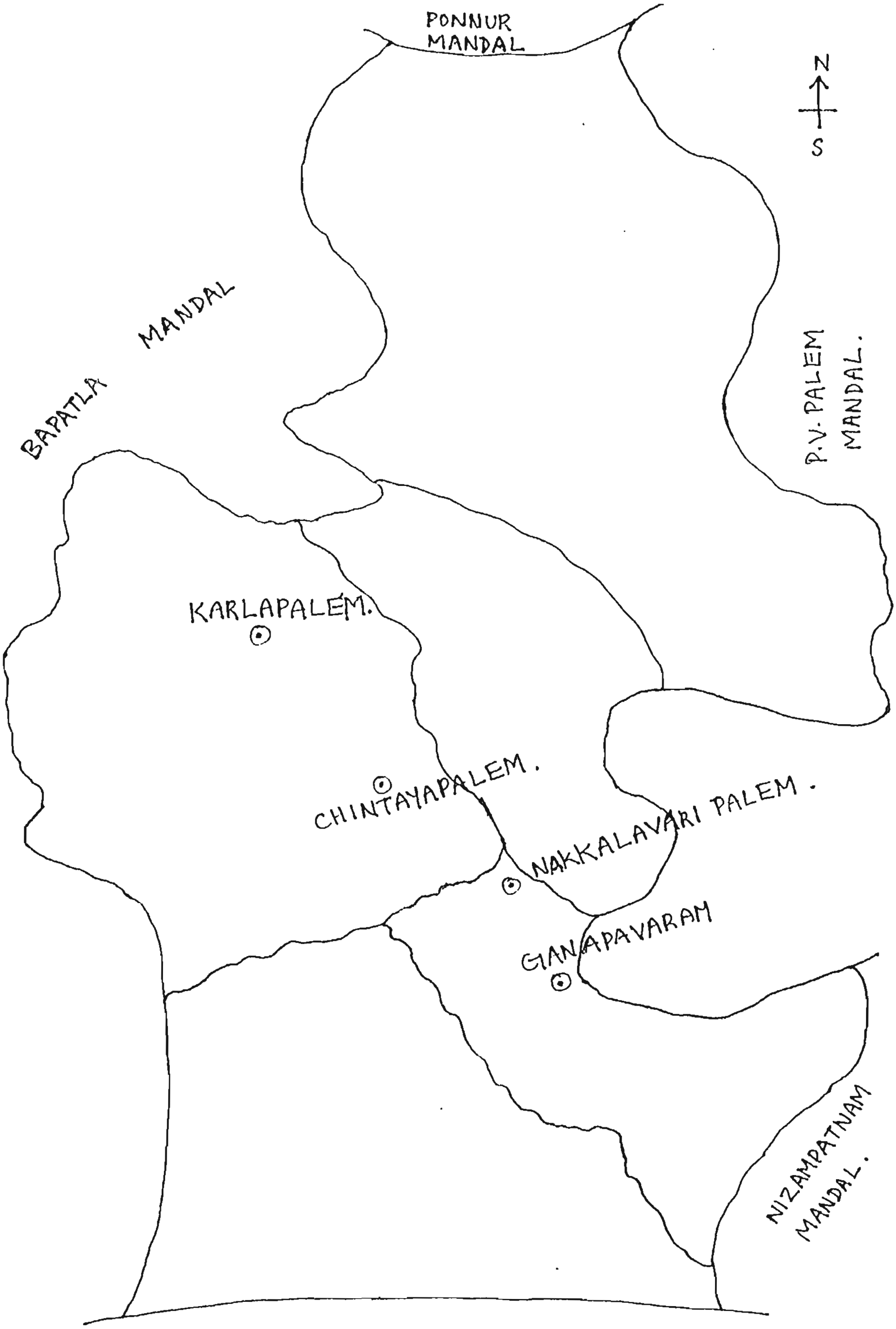
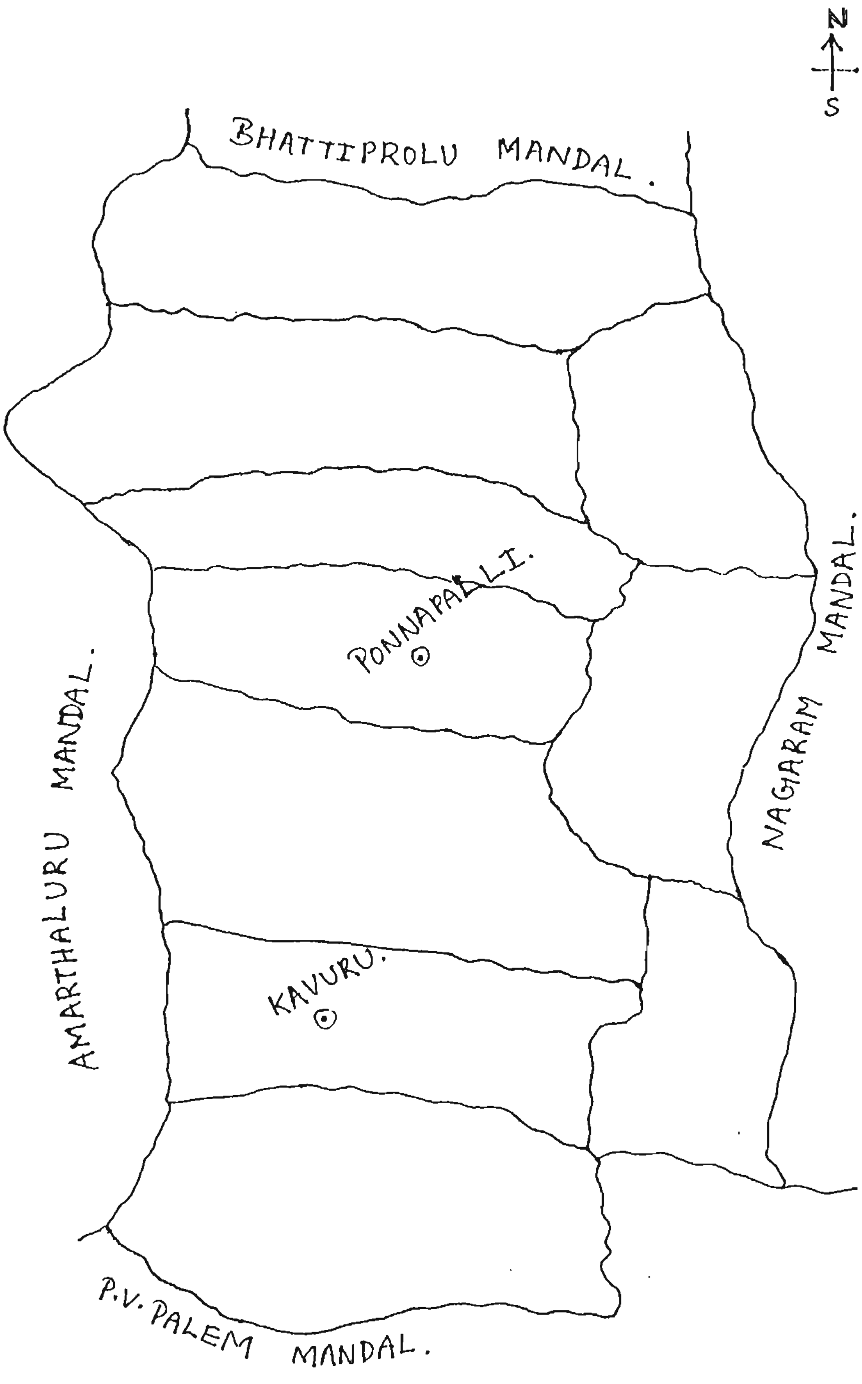


Fig. 4.3 MAP OF CHERUKUPALLI.



4.2.1.2 Ganapavaram village

The village comprises 1,330 males and 1,317 females and this constitute the total population of 2,647, out of which literates are 49.26 per cent. The net area sown annually is 802.39 hectares.

4.2.1.3 Karlapalem village

The total population of the village is 1,819 which comprises 942 males and 876 females. The literates constitute 39.80 per cent. The net area sown annually is 1,097.58 hectares.

4.2.1.4 Nakkalavaripalem

The total population of the village is 1,241 out of which 624 are males and 617 are females. 32.80 per cent of population are literates. The net area sown annually is 248.87 hectares.

4.2.2 Cherukupalli

Amarthaluru, P.V. Palem, Nagaram and Bhattiprolu mandals form the four boundaries of Cherukupalli mandal with a total geographical area of 9,695 hectares. The total population of the mandal as per 1991 census is 57,164. There are 974 females for every 1000 males. Net area sown during 1998-'99 was 7,519.6 hectares.

4.2.2.1 Kavur village

The village comprises 3,029 males and 3,154 females and thus constitute the total population 6,183. The per cent of literates is 40.19. The net area sown annually is 1,621.08 hectares.

4.2.2.2 Ponnapalli village

The total population of the village is 2,817, out of which 1,371 are males and 1,446 are females 45.29 per cent of the population are literates. The net area sown annually is 1,013.04 hectares.

Results & Discussion

CHAPTER - V

RESULTS AND DISCUSSION

The data collected was tabulated, analysed and the results obtained from the current study are presented and discussed in this chapter, under the following heads.

5.1 General characteristics of the sample farmers

5.2 Economics of groundnut crop

5.3 Resource use efficiency in groundnut

5.4 Factors influencing IPM technology

5.4.1 Value of inputs saved due to IPM

5.4.2 Value of extra output obtained under IPM

5.5 Adoption of IPM technology

5.5.1 Levels of adoption

5.5.2 Constraints in the adoption

5.1 GENERAL CHARACTERISTICS OF THE SAMPLE FARMERS

The general characteristics of the respondents, both IPM and non-IPM are presented in Table 5.1. The average size of the family was found to be around six with two males, two females and two children in case of IPM, while it was around seven with two males, two females and three children, in case of non-IPM peasants. The average size of the groundnut holding was 1.82 and 2.15 hectares in case of IPM and non-IPM adopters, respectively. The average age of cultivators was 43 years in case of IPM and 49 years in case of non-IPM farmers.

A perusal of Table 5.2 reveals that 48.75 per cent of IPM adopters and only 22.5 per cent of non-IPM adopters had secondary

Table 5.1 : General characteristics of sample farmers

S.No.	Particulars	Average	
		IPM	Non - IPM
1	Age of respondents	43	49
2	Family composition		
	a. Males	2.05	2.35
	b. Females	1.75	1.85
	c. Children	1.60	3.05
3	Size of groundnut holding (ha)	1.82	2.15

Table 5.2 : Educational status of the sample respondents

S.No.	Educational status	Number		Percentage	
		IPM	Non- IPM	IPM	Non –IPM
1	Illiterate	7	15	8.75	37.5
2	Primary	21	11	26.25	27.5
3	Secondary	39	9	48.75	22.5
4	College	13	5	16.25	12.5
	Total	80	40	100.00	100.00

education. No much difference was observed between the peasants of IPM (26.25%) and non-IPM (27.5%) regarding primary education. Respondents having college education were high in case of IPM (16.25%) than non-IPM (12.5%). More number of illiterates were among non-IPM farmers (37.5%) and less in IPM adopters (8.75%).

As a whole, 91.25 per cent of the IPM respondents were literates, whereas in case of non-IPM adopters per-centage of literacy was 62.5. The results obtained shows that educational status of farmers contributed positively to the adoption of IPM technology. Pro rata increase was observed in the adoption of IPM technology with increase in the literacy per-centage. This is in confirmity with the results of Musser *et al.*(1986) which state that the educational programmes influenced the beliefs of users and non-users in adopting and prolonged use of IPM technology.

The other crops that are being grown by the respondents in the study area are Paddy and Blackgram.

5.2 ECONOMICS OF GROUNDNUT CROP

In the present study, a difficulty was experienced to distinguish between users and partial users of IPM programmes. As a result, technology become more widely accepted and this supported the same observation concluded by Hatcher and Wetzstein (1984). The following costs, therefore were included under the explanatory variable i.e., Plant protection technology along with the cost of IPM technology.

1. Labour cost on additional number of ploughings and intercultivations than the recommended number for groundnut crop.
2. Material and labour costs of fungicides and pesticides.

The costs, returns and Benefit-Cost ratios of groundnut per hectare by using IPM and non-IPM technology are presented in Table 5.3. It is evident that human labour occupied a major portion, followed by seed and plant protection technology costs. The per cent contribution of fertilizers to the total cost was very low in case of IPM (8.59%) and almost equal to traditional (8.98%) practice.

A cursory examination of Table 5.3 further reveals that the cost of cultivation of groundnut with IPM was less by Rs. 585.83 per hectare, in comparison to non-IPM technology. The results obtained are in congruity with the outcomes of Phipps (1993) who said that IPM technology had significant impact on reducing the tonnage thereby also reducing the costs of nematicides and fungicides used for groundnut production.

As evident from Table 5.3, the gross and net incomes obtained were higher to the extent of Rs.4687.50 and Rs. 5273.33 per hectare, respectively in IPM than in farmer's practice adopted farms. The results are in confirmity with the conclusions that IPM gave additional returns of Rs.2,914 and Rs.2,048 on BPH resistant and susceptible varieties of paddy respectively. It also saved Rs.478 per hectare on pest control (Krishnaiah *et al.*, 1986).

The results also confirmed the findings of Hatcher and Wetzstein (1984) wherein they indicated that IPM technology has increased net returns for groundnut producers.

According to Wightman (1994), enhanced productivity and profitability could be achieved with IPM technology. The current results are in confirmity with these findings.

Table 5.3 : Economics of groundnut crop per hectare using IPM and non – IPM technology

S No.	Particulars	Amount (Rs.)		% to total	
		IPM	Non - IPM	IPM	Non-IPM
1	Human labour	8,639.06	8,902.81	32.11	32.38
2	Traction power	2,480.63	2,596.88	9.22	9.45
3	Seeds	5,780.00	6,344.00	21.48	23.08
4	Manures	2,953.13	2,610.94	10.98	9.49
5	Fertilizers	2,311.89	2,467.63	8.59	8.98
6	Plant protection technology	4,742.31	4,570.59	17.62	16.62
7	Total cost	26,907.02	27,492.85	100.00	100.00
8	Gross income	47,765.63	43,078.13	--	--
9	Net income	20,858.61	15,585.28	--	--
10	Benefit – Cost ratio.	0.78	0.57	--	--

The Benefit-Cost ratios were 0.78 and 0.57 in case of IPM and non-IPM farms respectively, indicating that the returns per rupee of investment was Rs.0.78 and Rs.0.57, respectively. The results are in accordance with the study conducted by chowdry and Seetharaman (1997) in Guntur district on cotton, where they found that benefit-cost ratios were 0.49 and 0.79 in farmer's practice and IPM, respectively.

5.3 RESOURCE USE EFFICIENCY IN GROUNDNUT

Having studied the economics of groundnut cultivation, it would be necessary to study the relative resource use efficiency of each input in the production relationship. For this purpose Cobb-Douglas poduction function was employed with gross income (Rs.) as endogenous variable and human labour (Rs.), traction power (Rs.) seeds (Rs.), manures (Rs.), fertilizers (Rs.) and plant protection technology (Rs.) as exogenous variables.

The results obtained from the multiplicative production function are furnished in Table 5.4 and Table 5.5 for IPM and non-IPM adopted respondents. The coefficient of multiple determination (R^2) indicated that 93.25 per cent and 90.85 per cent of variation exists in gross income in case of IPM and non-IPM adopters. This was contributed by the independent variables included in the function. The remaining 6.75 per cent (in case of IPM) and 9.15 per cent of variation (in case of farmer's practice) might be due to some other factors, which have not been captured in the model.

In case of IPM farms (Table 5.4) the expenditure on human labour, manures and plant protection technology was positively contributing to the gross income and was significant at 5 per cent level of

Table 5.4 : Regression coefficients of factors influencing gross income by using IPM technology (n = 80)

S.No.	Variable	Regression Coefficient	Standard error	"t" value
1	Expenditure on (X_1) Human labour (Rs)	1.06624*	0.15023	7.09761
2	Expenditure on (X_2) Traction power (Rs)	0.00887	0.01484	0.59749
3	Expenditure on (X_3) Seeds (Rs)	0.09584	0.07163	1.33809
4	Expenditure on (X_4) Manures (Rs)	0.29408*	0.03950	7.44486
5	Expenditure on (X_5) Fertilizers (Rs)	0.01021	0.03608	0.28309
6	Expenditure on (X_6) Plant protection technology (Rs)	0.04617*	0.01396	3.30859

Intercept	:	0.11896
R^2	:	0.93246
Σb_i	:	1.52142

* Significant at 5% level of probability.

probability. The elasticity coefficients of human labour, manures and plant protection tehnology were 1.06624, 0.29408 and 0.04617 respectively. This indicated that one per cent increase in expenditure on human labour, manures and also in plant protection technology would result in increasing the gross income by 1.07, 0.29 and 0.05 per cent respectively, *ceteris paribus*. Variables like traction power, seeds and fertilizers although contributing positively to the gross income, however were not significant. The returns to scale was 1.52142 indicating the increasing returns to scale.

In case of non-IPM adopters, the variables contributing positively to gross income and significant at 5 per cent level of probability were human labour, seeds and manures (Table 5.5). The respective output elasticities of human labour, seeds and manures were in the order of 0.45583, 0.48882 and 0.23016. This indicated that the resultant increase in gross income, with one per cent increase in expenditure on human labour, seeds and manures was 0.46, 0.49 and 0.23 per cent respectively, provided all other factors are kept constant. Table shows that the explanatory variable i.e. fertilizer was not significant although it contributed positively to the gross income. Variables viz., traction power and plant protection technology had contributed negatively to the gross income and were not significant. Increasing returns to scale has ben observed, as the returns to scale was 1.18735.

The results supported the findings of Satpute and Bhole (1974) on cotton for the variables human labour and manures. It also supported the findings of Sunandini *et al.* (1993) for the variables traction power and manures.

Table 5.5 : Regression coefficients of factors influencing gross income by using non - IPM technology (n = 40)

S.No.	Variable	Regression Coefficient	Standard error	"t " value
1	Expenditure on (X_1) Human labour (Rs)	0.45583*	0.21342	2.13586
2	Expenditure on (X_2) Traction power (Rs)	- 0.00183	0.00236	0.77409
3	Expenditure on (X_3) Seeds (Rs)	0.48882*	0.14125	3.46064
4	Expenditure on (X_4) Manures (Rs)	0.23016*	0.05516	4.17249
5	Expenditure on (X_5) Fertilizers (Rs)	0.01779	0.09239	0.19256
6	Expenditure on (X_6) Plant protection technology (Rs)	- 0.00343	0.04301	0.07972

Intercept : 1.66894

R^2 : 0.90852

$\sum b_i$: 1.18735

* Significant at 5% level of probability.

For the variable fertilizer, the outcomes obtained are in contrary to the findings of Satpute and Bhole (1974), Haque (1985) and Sunandini *et al.* (1993).

The analysis of log-log linear production function indicated that the expenditure on human labour and manures was contributing positively and significantly to the gross income in both the cases of IPM and farmer's practice. In addition to this expenditure on plant protection technology in case of IPM and expenditure on seeds, in the case of farmer's practice were contributing positively and significantly to the gross income. In case of non-IPM adopted farms the variables viz., traction power and plant protection technology had contributed negatively to gross income, however not significant. Increasing returns to scale has been observed in both IPM and traditional practices.

5.4 FACTORS INFLUENCING IPM TECHNOLOGY

After studying the relative resource use efficiency in groundnut production, it is obvious to decompose the total charge on the dependent variable by applying decomposition analysis. By applying decomposition equation and also by using the values of production parameters and the input levels, total change in per acre income of groundnut has been decomposed with IPM technology. The results of these are presented in Table 5.6. Per acre production of groundnut with IPM technology was 10.06 per cent higher than non-IPM technology.

A perusal of Table 5.6 further reveals that the contribution of technical change to total change in income was estimated to be 10.88 per cent. This indicated that 10.88 per cent additional income per acre could be obtained by the adoption of IPM technology. This is possible

Table 5.6 : Decomposition analysis of total change in per acre groundnut income between IPM and non – IPM production technology

Item	Percentage attributable
Total change in measured income	10.10
Sources of change	
1. Technical change	10.88
2. Change in inputs	
Human labour	-3.19
Traction power	-0.04
Seeds	-0.88
Manures	3.33
Fertilizers	-0.08
Plant protection technology	0.04
Total due to input change	-0.82
Total due to all sources	10.06

with the present level of inputs viz., human labour, traction power, seeds, manures, fertilizers and plant protection technology. It has been observed that an essential ingredient of technical change is a shift in the production function. A greater income can be obtained from a given level of inputs. Further, an increase in the use of manures and plant protection technology and a decrease in use of human labour, traction power, seeds and fertilizers contributed to -0.82 per cent of the increased income (10.10%). To the estimated -0.82 per cent contribution, the contribution of manures (3.33%) is the highest, followed by plant protection technology (0.04%), traction power (-0.04%), fertilizers (-0.08%), seeds (-0.88%) and human labour (-3.19%).

The results supported the findings of Bisaliah (1977) that 40 per cent higher production of wheat per acre has been achieved with new technology rather than with old technology. The proportion due to technical change was 15 per cent.

According to Kiresur *et al.* (1995), productivity per hectare was higher (45%) in sorghum, with modern varietal technology over traditional. The findings of the present study supported this.

The outcomes also confirmed the results of Huang and Rozelle (1996). In their study the most important determinant of rice yield growth during 1978-'84 was technology adoption which accounted for 40 per cent of the change.

While the results obtained by Cauvery (1991) are in contrary to the present findings where a seven factor decomposition model was employed. Cauvery concluded that the increase in groundnut supply was due to greater area under cultivation as opposed to higher productivity in the effect of modern technology.

5.4.1 Value of inputs saved due to IPM

The value of additional resources required to produce IPM technology level of income by non-IPM was Rs.1155.29 per acre (Table 5.7). This indicated that the farmer would have required additional resources valued at Rs.1155.29 per acre to attain the present level of income during the study period in the absence of IPM technology. This magnitude of a resource saving was due to an upward shift in the production function or a downward shift in the unit cost function with the introduction of IPM technology[1].

The outcomes are in support of the findings obtained by Bisaliah (1977) as the value of inputs saved due to new technology in wheat was Rs.67 per acre.

5.4.2 Value of extra output obtained under IPM

It is evident from Table 5.8 that the value of extra output accrued to groundnut using IPM technology during study period without any additional cost on resources was 0.13 quintals and Rs.198.08 in physical and monetary terms. Further, per acre income with IPM technology was more (Rs. 18,948.29) as compared to farmer's practice (Rs.17,127.74). Percentage increase in income per acre under IPM technology with the non-IPM technology volume of all selected exogenous

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1. Cost function and the underlying Cobb-Douglas production function are related to each other by the duality theorem. Sidhu estimated that the unit cost function shifted downwards in the order of 15.54 per cent.

Sidhu S S 1972 Economics of technical change in wheat production in Punjab (India), Ph.D. Dissertation, University of Minnesota, St. Paul, U.S.A.

Table 5.7 : Value of inputs saved due to IPM technology of groundnut production during 1999 - 2000

Item	Value
R_{NT}	Rs. 10,618.53
R_{OT}	Rs. 11,773.83
r (%)	0.1088
Value of inputs saved (S_R) per acre	Rs. 1,155.29

Table 5.8 : Value of extra output per acre under IPM technology level of inputs during 1999 – 2000

Item	Value	
	Physical terms	Monetary terms
Y_{NT}	12.06 qtl.	Rs. 18,948.29
Y_{OT}	10.90 qtl.	Rs. 17,127.74
Δ Y	1.16 qtl.	Rs. 1,820.55
r (%)	0.1088	0.1088
Value of extra output obtained (Δ Y)(r)	0.1 qtl.	Rs. 198.08

variables per acre was 0.1088. The results are in accordance with the outcomes obtained by Bisaliah (1977) as the value of extra output in wheat due to improved technology was 61 kg per acre.

By summing up the results of decomposition analysis, it has been observed that the contribution of technical change to total change in income was 10.88 per cent. Change due to inputs however was negative. Factors like manures (3.33%) and plant protection technology (0.04%) had shown increasing effect. A reverse trend was noticed in human labour (-3.19%), traction power (-0.04%), seeds (-0.88) and fertilizers (-0.08%) under IPM technology. The value of inputs saved due to IPM practice was Rs.1155.29 per acre while the value of extra output obtained per acre under IPM with non-IPM volume of inputs was 0.13 quintals or Rs.198.08 per acre.

5.5 ADOPTION OF IPM TECHNOLOGY

After analysing the factors which influence IPM technology, it is necessary to study the levels of adoption and constraints in the adoption of IPM.

5.5.1 Levels of Adoption

It is obvious that the level of adoption of IPM technology was higher in groundnut as lower value of the technology index (9.81%) implied a higher level of adoption (Table 5.9). The adoption pattern of the IPM cultivators was not upto satisfactory level, as it is clear (Table 5.10) with an adoption index of 58.43 per cent.

Table 5.9 : **Technology Index**

Potential yield (kg/ha)	Actual yield (kg/ha)	Technology Index (%)
3,039.63	2,741.34	9.81

Table 5.10 : **Adoption index**

Average adoption score by the farmers	Possible score	Adoption Index (%)
4.09	7	58.43

This trend was being in correlation with the outcomes of decomposition analysis, where technical change contributed to the total change in income to the extent of 10.88 per cent only, though it was the major contributor.

5.5.2 Constraints in the Adoption

After discussing the indices, it would be more appropriate to probe into the constraints faced by the adopters in adoption of IPM technology during the study period.

The constraints that are perceived and identified in adoption of IPM technology are grouped into social, economic, institutional and feasibility of implementation factors. The grouping of constraints was necessary because, the technology should be technically sound, economically feasible, easily adoptable and socially acceptable to ensure adoption by the farmers. Fourteen constraints have been identified in adoption of seven IPM technologies on groundnut. These are presented in the form of matrix (Table 5.11). The constraints noticed are as follows:

Social	:	1. Not known	2. Not convinced
		3. Non availability	4. Traditionally bound
		5. Laziness	6. Belief.
Economic	:	7. Poor technology	8. Costly.
Institutional	:	9. Small size of groundnut holding	
		10. Poor educational status	11. Age.
Feasibility of Implementation	:	12. Lack of skill	13. Lack of time
		14. Complexity.	

Table 5.11 : **Technology constraints matrix for IPM adopted groundnut farmers**

IPM technologies	*Constraints 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Clean cultivation and summer ploughing	-	18.75	50	12.5	11.25	15	11.25	90	85	7.5	10	5	5	3.75
2. Trap cropping with sunflower/castor	-	35	68.75	35	20	40	6.25	-	75	10	11.25	5	3.75	2.5
3. Use of pheromone traps	13.75	68.75	75	30	37.5	85	11.25	7.5	90	12.5	55	6.25	5	3.75
4. application of Neem kernel extract.	10	35	16.25	12.5	60	65	10	15	75	5	5	-	3.75	2.5
5. Manual collection of larvae and egg masses	11.25	45	71.25	40	50	40	11.25	90	12.5	7.5	10	6.25	5	3.75
6. Application of fungicide i.e., chlorothalonil	15	25	20	22.5	6.25	50	-	27.5	11.25	43.75	18.75	5	3.75	2.5
7. Application of NPV	25	71.25	75	30	35	41.25	7.5	15	12.5	12.5	40	-	6.25	6.25

* Constraints : Social : 1. Not Known 2. Not convinced 3. Non availability 4. Traditionally bound 5. Lazyness 6. Belief
Economic : 7. Poor technology 8. Costly
Institutional : 9. Small size of groundnut holding 10. Poor educational status 11. Age
Feasibility of Implementation : 12. Lack of skill 13. Lack of time 14. Complexity

By probing into the constraints it was clear from Table 5.11 that institutional factors are the important factors responsible for technology adoption and majority of the farmers were not adopting this because of small holdings with reference to trap cropping, use of pheromone traps and spraying of neem kernel extract. High cost (Economic constraints) of clean cultivation and summer ploughing and manual collection of larvae and egg massess affected adoption of technology. Among the social factors, belief of the farmers regarding application of fungicide and non availability with reference to application of NPV were the dominating constraints in the adoption of IPM technology.

As a whole, institutional and social factors were hindering the adoption process. Economic constraints were less important in view of profitability. Feasibility factors were of least concern in the adoption of IPM technology.

In order to find out significant differences among the constraints in the adoption of IPM technological practices, a non-parametric statistic i.e. Friedman's test was employed.

The adjusted Friedman's test statistic value (23.517) was found to be significant at five per cent level of probability. Hence, it is concluded that there was significant difference among the constraints in the adoption of IPM technology. It means that each constraint has its own value in affecting the adoption of technology.

The outcomes obtained are in congruity with the findings of the study conducted by Eswara Prasad *et al.*(1996) in Kodimial watershed area in Karimnagar district of Andhra Pradesh. They applied Friedman's test and found significant differences among the fifteen constraints in the adoption of technological practices under each of three crops viz., maize, greengram and groundnut. Out of four groups of constraints viz., social, economic, feasibility and environmental, social and economic constraints were responsible for non-adoption of some technological practices.

Summary

CHAPTER - VI

SUMMARY

Pesticides emerged as an important agricultural input with the advent of green revolution. Control of pests continue to be crucial for the farmers and excessive and indiscriminate use of pesticides resulted in pest resistance, pest resurgence and secondary pest outbreaks, general environmental pollution and ecological imbalance. To combat this adverse situation, a co-ordinated approach called, Integrated Pest Management (IPM) technology came into focus, combining the various control measures like chemical, cultural, biological and mechanical to maximise economic benefits and minimise negative environmental effects. In this context an attempt is made to study economic aspects of IPM technology in groundnut production with the following objectives.

1. To study the relative resource use efficiency in groundnut production using IPM technology.
2. To analyse the factors influencing IPM technology in groundnut production.
3. To examine and identify the constraints in the adoption of IPM technology in production of groundnut.

METHODOLOGY

Guntur district was selected purposively as IPM technology was implemented in groundnut during 1992-'94 covering two seasons by ICRISAT and ANGRAU with the guidance of scientists of Krishi Vigyan Kendra, Kavur in four villages, out of which three viz., Karlapalem, Ganapavaram and Nakkalavaripalem were from a mandal i.e., Karlapalem and one village viz., Kavur from the Cherukupalli mandal.

These two mandals and four villages were purposively selected. In order to study the impact of IPM technology, two non-IPM adopted villages viz., Chintayapalem from Karlapalem mandal and Ponnapalli from Cherukupalli mandal were randomly selected, which are situated 6-20 km away from the IPM adopted villages.

A sample of 120 farmers was selected out of which 80 hailed from four IPM adopted villages and 40 were from two non-IPM adopted villages. Proportionate random sampling technique was applied. The sample farmers were interviewed personally with pre-tested and well-structured schedules. The data collected was pertaining to the agricultural year 1999-2000.

Tools of Analysis

Tabular analysis was used to compute sample means and percentages to study the general characteristics of sample respondents, costs and returns of groundnut cultivation, Benefit-Cost ratios etc. Cobb-Douglas production function was fitted to study the relative resource use efficiency of IPM technology. Decomposition analysis was employed to analyse the factors influencing IPM technology and to estimate the value of inputs saved and extra output obtained due to IPM practice. Technology and adoption indices were used to know the levels of adoption of IPM. Friedman's test was applied to examine and identify the constraints in the adoption of IPM technology in groundnut production.

MAJOR FINDINGS

General Characteristics of the Sample Farmers

The average size of the family was around six members. Groundnut holding was 1.82 hectares. Average age was 43 years and per cent of literates was 91.25, in case of IPM adopters. In case of non-IPM farmers, average size of the family was around seven members with an average age of 49 years. Groundnut cultivated area was 2.15 hectares with 62.5 per cent literates.

Economics of Groundnut Cultivation

The average total cost of production of groundnut was Rs. 26,907.02 and Rs. 27,492.85 per hectare in case of IPM and non-IPM, respectively. Gross returns obtained in case of IPM was Rs. 47,765.63 and in case of farmer's practice it was Rs. 43,078.13 per hectare. IPM on groundnut yielded additional gross returns of Rs.4687.50 and net returns of Rs.5273.33 besides saving Rs.585.83 per hectare on the cost of production.

Resource use efficiency in groundnut

The analysis of double log linear production function indicated that in both the cases of IPM and non-IPM technology, expenditure on human labour and manures were contributing positively and significantly to the gross income. Non-significantly and positively contributing variables to gross income were traction power, seeds and fertilizers in case of IPM and only fertilizers, in case of traditional practice. Variables like traction power and plant protection technology were contributing negatively and non-significantly. Plant protection technology which includes IPM was contributing positively and significantly to gross income, in case of IPM adopted farms. Increasing returns to scale was observed in both IPM (1.52142) and non-IPM (1.18735) practices.

Factors influencing IPM technology

Decomposition analysis revealed that the contribution of technical change to total change in income was 10.88 per cent and change due to inputs was negative (-0.82). Factors like manures (3.33%) and plant protection technology (0.04%) had shown increasing effect while reverse trend was noticed in human labour (-3.19%), traction power (-0.04%), seeds (-0.88%) and fertilizers (-0.08%) under IPM technology. The value of inputs saved due to IPM practice was Rs.1155.29 per acre while the value of extra output obtained per acre under IPM with non-IPM volume of inputs was 0.13 quintals or Rs.198.08 per acre.

Adoption of IPM technology

The adoption pattern of IPM respondents was not upto satisfactory level with an adoption index of 58.43 and technology index of 9.81 per cent. The same trend was noticed while decomposing the total change in income where technical change contributed to the extent of 10.88 per cent only.

Fourteen constraints have been identified in adoption of seven IPM technologies on groundnut under three groups viz., social, economic, Institutional and feasibility of implementation factors. Institutional and social constraints were hindering the adoption process. Majority of the farmers were not adopting due to small size of holdings with reference to trap cropping, use of pheromone traps and spraying of neem kernel extract. High cost (Economic factors) of clean cultivation and summer ploughing and manual collection of larvae and egg masses affected adoption of technology. Economic constraints were less important in view of profitability. Among the social factors, belief of the farmers regarding application of fungicide and non availability with reference to application of NPV were the dominating constraints. Feasibility factors were of least concern in the adoption of IPM technology. Outcomes of Friedman's test indicated that there was significant difference among the constraints and each constraint had its own value in effecting the adoption of technology.

CONCLUSIONS

The following conclusions have emerged based on the results of the present study.

* Per cent of literates was more in IPM than non-IPM users indicating that the educational status influenced the adoption of IPM technology.

* The cost of cultivation of groundnut with IPM was less than that of non-IPM technology adopting farms.

* Gross and net returns were higher in groundnut crop using IPM when compared to the farmer's practice.

* Benefit-cost ratio revealed that the rate of return per rupee of investment was more on farms with IPM practice.

* The results of Cobb-Douglas production function revealed that IPM technology contributed positively and significantly to the gross income.

* Outcomes of decomposition analysis indicated that the total change in income was due to technical change, but, not due to input change.

* The results of decomposition analysis revealed that an increased use of manures and plant protection technology and decreased use

of human labour, traction power, seeds and fertilizers under IPM technology contributed accordingly to the increased income.

* The magnitude of resource saving was due to an upward shift in the production function or a downward shift in the unit cost function with the introduction of IPM technology.

* With no additional cost on resources, extra output was obtained and inputs were saved with IPM technology.

* By observing the technology and adoption indices, the adoption pattern of the respondents was not upto the satisfactory level.

* Institutional and social factors were hindering the adoption process. Economic constraints were less important in view of profitability. Feasibility factors were of least concern in adoption of IPM technology.

* Friedman's test revealed that each of fourteen constraints identified, had its own vaue in affecting the adoption of technology.

POLICY IMPLICATIONS

* Extension system should be strengthened so as to put constant and continuous efforts in making the farmers for adopting the technology.

* Training programmes must be conducted from time to time to make the farmers aware of the ill effects of excessive and indiscriminate use of pesticides.

* Result demonstrations should be taken up on large scale to educate and make the farmers to adopt IPM technology.

* Research efforts should be directed towards developing multiple resistant varieties.

* The research station-extension agency-farmer link must be strengthened to have proper feed back of information from farmers to the scientists at the research stations.

* Massive production of the biological agents should be taken up by the Government agencies and the same must be provided to the farmers at subsidised prices.

* Latest technology should be made available through progressive farmers, popular dailies, leaflets, journals and other mass media channels like Radio and Television.

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