A RESOURCE ECONOMIC STUDY OF ORGANIC FARMING SYSTEM IN HIRIYUR TALUK, CHITRADURGA DISTRICT, KARNATAKA

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CERTIFICATE

This is to certify that the thesis entitled "A **RESOURCE ECONOMIC STUDY OF ORGANIC FARMING SYSTEM IN HIRIYUR TALUK, CHITRADURGA DISTRICT, KARNATAKA"** submitted by **Mrs. Harishilpa, G.R.,** in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **AGRICULTURAL ECONOMICS** to the University of Agricultural Sciences, Bangalore, is a record of bonafide research work carried out by her during the period of her study under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma associateship, fellowship or other similar titles.

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GLOSSARY

The concepts and variables used in this study are defined below:

Human labour: Labour measured in mandays and womandays for different farm operations in cultivation of sunflower, groundnut and paddy. The wage rate for a manday was Rs.40 and for a womanday was Rs.25 for eight hours of work with food.

Bullock labour: The wage rate for a bullock pair day was Rs.150 for eight hours of work.

Tractor labour: The hire charge of tractor is Rs. 1000 for six hours

Seed cost: Expenditure incurred on the seed is considered for imputing.

FYM, Gobar gas slurry: The quantity of gobar gas slurry and FYM used in the cultivation of sunflower, groundnut and paddy is measured in terms of tractor loads. The cost was imputed at the market price in the village.

Concentrated organic manure: The quantity of concentrated organic manure (COM) like oilcakes used in the cultivation of crops (measured in quintals) and the cost was imputed by taking the actual market price.

Green manure: The cost of green manure was estimated in terms of bundles and the prevailing market price was considered for accounting.

Fertilizers: Refer to the quantity of fertilizers (quintals) used by FPIA. The cost was imputed by considering the price of the fertilizers used.

Plant protection chemicals (PPC): The PPCs used is valued at the price paid by the farmers. FPOA were using biopesticides while FPIA used synthetic pesticides.

Irrigation cost: The farmers in the study area are located in central dry agroclimatic zone. In an earlier study the value of groundwater for irrigation was estimated at Rs. 211 per acre inch in central dry zone, during 1995-96. In this study, the groundwater used was valued at Rs. 211 per acre inch of water for those farmers who used groundwater from wells for irrigation. For farmers using canal irrigation, the cost of irrigation per crop as fixed by the government was taken for computing irrigation cost (Rs. 35 for paddy per crop per year and Rs. 24 for groundnut per crop per year).

Marketing cost: The transportation cost and commission charges were imputed and considered as marketing cost.

Interest on working capital: This was calculated at the rate of 12.5 per cent per annum on the value of FYM, fertilizers, other organic manure, seeds, PPC and labour (including man, woman, bullock, tractor).

Rental value of land: Ten per cent of gross return was taken as rental value as the rental value of the land in the study area was not available.

Cost of cultivation: Includes both variable cost (cost of FYM, fertilizers, irrigation, plant protection chemicals, seeds, labour, concentrated organic manure and interest on working capital) and fixed cost (rental value of land).

Total cost: Includes cost of cultivation and marketing cost.

Gross returns: The gross return was calculated by multiplying the total output with post harvest price.

Net returns: Is the returns obtained by subtracting total cost from gross returns.

Externality: Is variously known as external effect, external economies and diseconomies. Externality involves an interdependence of utility, there are two types of externalities-positive and negative.

Positive externalities are uncharged benefits and negative externality is the unreimbursed cost.

The unreimbursed cost in inorganic agriculture are the, ill effects of using fertilizers and pesticides both on soil and humans. The decreased productivity levels of soils may be attributed to the use of excess chemical fertilizers instead of organic manures. The pesticidal residues in the output may lead to various health hazards in humans and the increased cost of production with no proportionate increase in the output levels in FPIA is of concern.

The uncharged benefits of organic agriculture are many some of which are increased soil productivity and fertility, increased water holding capacity of the soil and most important one is the produce free from chemical residues.

INTRODUCTION

CHAPTER I

INTRODUCTION

"Krishito Naasti Dhurbhiksham (famine vanishes through farming)"

India's population is expected to increase by 100 millions and 150 millions by 2000 and 2025 AD respectively, and requires 240 million tonnes and 325 million tonnes of food grains. The country has to raise food production by 5 million tonnes per year as against the present level of 3.1 million tonnes per year to meet the growing demand. The ever growing population of India triggers the transition from traditional practices to modern science based agriculture, which led to the advances in various disciplines of agricultural sciences together with technological growth. This led to the conviction that, modern agricultural growth is progressively inevitable, as it is beneficial while the quantitative leap due to modern agricultural technology was appreciable, the process discounted qualitative parameters *inter alia*:

1. Toxicity and residual effects of agricultural chemicals.
2. Amines produced from nitrogenous fertilizers could cause cancer.
3. Property of pesticide and herbicide residue is to affect the central nervous system, respiratory system and gastrointestinal system of humans.
4. Inevitability of pesticide resistance and resistance to weedicides.
5. Soil erosion due to poor organic matter content to bind fine topsoil particles, eroded soil particles carried by water, end up in reservoirs, thereby increasing the costs of water use.

6. Applying of nitrogenous fertilizers in excess of the amount removed each year with the crop can lead to loss of nitrogen from the soil environment, as they are poorly stored in the soil. Nitrate leaches into ground water, which contaminate the wells, and nitrates in drinking water.
7. Workers, who handle pesticides for more than twenty days a year, have an increased risk of cancer.
8. Green house gas emanating from fertilizer application, damages ozone layer.
9. The demands of modern agriculture have led to monocropping and narrowing of the crop genetic base. The quantitative success of newly bred and selected strains has led to their adoption by farmers by abandoning diverse landraces and wild relatives.

In agriculture, sustainability means development not only in quantity of output but also qualitative improvement in socioeconomic conditions. According to UNDP, safeguarding national food security implies improving the quality of the life of farming community by ensuring no further depletion of resource base. Organic agriculture is one of the diversified traditional farming systems aimed at agricultural sustainability. Modern agriculture has led to increased crop production, in the a short run- in the long run, to meet the food requirements maintenance of soil health, stability in production through use of organic and biological measures, are crucial.

Some of the definitions of organic farming are as under:-

1. "Farming in the spirit of organic relationship is organic farming (AME)".

2. "Organic farming is defined as a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock additives to the maximum extent feasible. Organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes and biological pest control to maintain soil productivity, to supply plant nutrients and to control insects, weeds and other pests (USDA, 1980)".

3. "Organic farming is a production system which favors maximum use of organic material (crop residues, animal excreta, legumes, on and off farm organic wastes, growth regulators, bio-pesticides) and discourages use of synthetically produced agroinputs, for maintaining soil productivity and fertility and pest management under conditions of sustainable natural resources and healthy environment (organic farming for sustainable agriculture – by Dahaman)".

Organic farming describes three major aspects

- Substitution of inorganic chemical fertilizers by organic manures.
- Use of biological pest and weed control instead of chemical pesticides and herbicides.
- Comprehensive management approach to improve soil health and sustain productivity.

Basic Principles of organic agriculture

1. Conventional/inorganic agriculture conflicts with nature. Nature itself is a biological capital to be used with prudence and wisdom.
2. Soil is the rich source of plant microclimate. It lodges the microorganisms directly beneficial to make soil productive. There is a need for rejuvenating the tired, overworked, degraded, polluted and malnutritioned soil to increase soil capacity to increase food production.
3. Diversification of production system by multistoried cropping/intercropping, with crop rotations will avoid risk and uncertainty and result in efficient use of soil nutrients.
4. Freedom from energy intensive inputs and decreased dependence on external inputs is desirable, to enhance farm efficiency.
5. The ecological harmony is ensured when flora and fauna co-exist in harmony and contribute to the productivity of the system.
6. Organic resources and wastes can be recycled and prudently managed.

Modern agriculture in India is fifty years old. In contrast, agricultural practices in India are more than 4000 years old and have maintained the soil fertility status over the long time horizon. Farmers of ancient India adhered to the natural laws while developing farming systems and practices. Following are some of the natural products they used for control of pests and diseases:

- Cottonseed treated with cowdung paste to facilitate sowing and control of seed borne diseases.
- Neem oil used against leaf minor, fruit sucking moths.

- *Pongamia glabara* (Honge) seed extract against ground beetle.
- *Clerodendron inermis* - Leaf paste (three kg) soaked in (ten litres) of cow urine overnight and diluted in (200 litres of) water, sprayed on gladiolus to control the insects feeding on it.
- Allicin from the aqueous extract of garlic has a broad-spectrum antibacterial property.
- *Agave sisalana*(Kattale) - crushed leaves are soaked in a water tank for 24 hours. Water from this tank is used to irrigate paddy to control pests.
- Nicotine extract from tobacco leaves is used against aphids.
- Napthoquinones isolated from *Calceolaria andian* is active against white flies, aphids and mites.
- Stroblurin a fungicide isolated from mushrooms inhibits sperm viability.

Some of the constraints which preclude organic farming are as under

1. Reduced availability of biomass, crop residues and other organic wastes on the farm.
2. Commercial production of biofertilizers and transportation facilities yet to take off.
3. Availability of varieties suitable to organic farming are limited especially due to domination of high yielding varieties, erosion of genetic base of local varieties.
4. Appropriate technologies for integrated pest and nutrient management (IP&NS) and farming system approach are still emerging.
5. Gap in achieving high and sustainable yield, is widening.
6. Lack of policies and encouragement in favour of organic agriculture.

7. Organic farm yield levels are not comparable to yield levels on inorganic/conventional farms.

The study on economics of organic farming and feasibility of organic farming are crucial to analyze the causes for the gap between organic and conventional farming. This study is a modest attempt to analyze the economics of organic farming in two major oilseed crops (sunflower, groundnut) and major cereal crop (paddy) in Karnataka. The specific objectives of the study are:

1. Estimation of costs and returns of crops cultivated on organically and inorganically producing farms and their comparative economics.
2. Analysis of resource productivity and allocative efficiency in the production of organically grown crops.
3. Study of labour use pattern in cultivation on organic and inorganic farms.
4. Estimation of externalities due to organic and inorganic cultivation.

Hypotheses

1. Net return from inorganic agriculture is lower than that from organic agriculture.
2. Elasticity of production of organic inputs is in the first stage of production function.
3. The requirement of labour in inorganic agriculture is higher than that of organic agriculture.
4. The positive externalities in organic farm constitute the higher net return on organic farm compared with inorganic farms.

Significance of the study

The market for agriculture produce is shifting from chemical intensive fertilizer produce to the organic produce. Though organic agriculture was a way of life in India, it eroded recently due to green revolution where agro chemicals were largely used to increase the food production. In order to capture the positive externalities of organic agriculture, this is a modest attempt to demonstrate the economic feasibility of organic agriculture in major oil seed crops and cereal crop in Karnataka.

Limitations of the study

The qualitative aspects of organic agriculture could not be captured in this study because soil fertility and productivity status could not be estimated. Further the produce could not be tested for the pesticide residue due to lack of appropriate facilities.

The sample farmers are large farmers practicing organic agriculture, as it was difficult to locate small farmers who were exclusively practicing organic agriculture.

Fig 3: Compost pit

Fig 4: Gobar gas plant

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

Horne (1973), opined that there are positive and negative external effects from using insecticides. He indicated that when certain insecticides are restricted in application, farmers still received higher net returns.

Fukuoka (1978), developed four principles of natural farming: (1) no cultivation, (2) no chemical fertilizers or prepared compost, (3) no weeding by tillage or herbicides and (4) no dependence on chemicals.

The findings of a comprehensive USDA (1980), study on organic farming in the U.S., Japan and Europe indicated organic farming movement covered a wide spectrum of practice not limited by size, motivated by concerns for conservation, health and cost control, use of modern techniques, equipment and management practices suited to crop live stock interdependence, less energy consuming, more labour intensive and less profitable than conventional/inorganic farming.

Charlene Price (1981), reported that organic food defined by USDA is produced without using synthetically compounded fertilizers pesticides, growth regulators or livestock feed additives and were based on soil, water, plant test and plan of growth.

Park (1986), examined problems in measuring externalities of pesticide usage in agriculture. The negative externalities considered are effect on humans,

animals and other environment. The study highlighted the difficulties in evaluating economically, the environmental and social cost and concluded that interdisciplinary research is desirable to find the alternatives.

Edwards (1987), stated that "sustainable agriculture is an integrated system of agricultural production that is less dependent on high inputs of energy and synthetic chemicals and more dependent on intensive management rather than conventional monocultural systems".

Reinken (1987), reported that a study conducted for eight years of comparative growing of apples and vegetables following biodynamic and inorganic rules at the experimental station proved that the yield levels were lower in biodynamic farming by 19 per cent for vegetables and 33 per cent for apples.

The study conducted by agriculture man ecology programme (1991) reported that productivity and sustainability of organic agriculture was higher compared to conventional or inorganic agriculture.

Tangaswamy (1991), reported that organic farming yields are comparable with inorganic farms yields and said organic farming was ecologically and economically sound sustainable way of production.

Bartola *et al.*, (1992) has identified four issues on the economics of organic agriculture (i) confusion of consumers over similar farming techniques (ii) the small scale individual nature of organic farming (iii) incorporation of agricultural and food policies, prices, technologies and quality differences and (iv)

role of organic farming in future reforms given the environmental and surplus problems of current policies.

Huang *et al.* (1992), conducted field trials to compare conventional, organic and intermediate farming systems for 2 crop rotations in sweet corn, vegetable soybean and phaseoulus concluded that yields and pest control in organic farming were unsatisfactory and that an intermediate system (organic + limited inputs of chemical fertilizers + pesticides) should be used at the first stage of transition from conventional to organic farming and the gross income in organic farming was low.

Profullachandra (1992), reported that the sugarcane trash converted into organic manure on the field increased the fertility level of soil and decreased cost of cultivation by saving yearly cultivation costs, prevented soil erosion, reduced intake of water and decreased water evaporation due to the natural mulch provided by the spread of sugarcane trash on the field.

Bagchee *et al.* (1993), indicated that the role of farm woman in India has not yet been translated into reorienting either agricultural research priorities or development schemes. Positive support and encouragement is needed for women to further their role in the development of agriculture. The paper argues that involving women farmers in mainstream development programmes is beneficial. Because the watershed development programme is a major thrust area in the eighth five-year plan, a beginning can be made by strengthening role of woman in agricultural resource management.

Rozyspal *et al.*, (1993) compared the economic results of winter wheat and spring barley production in organic and conventional farming in first and second years of the conversion to organic farming and concluded that the net income per hectare was higher in organic farming compared to conventional farming.

Sumelius (1993), has putforth arguments for extensification of agriculture. Extensification meant reduction in production surplus and reduction in production cost. Though extensification is not profitable, certain environmental goals can be met effectively by changing over to alternative agriculture.

Vivek and Julie (1993), reported that average yields of ragi and paddy in the initial year of switching over to organic farming was less but gradually increased and was comparable with the yield levels in inorganic agriculture.

Klonsky (1994), in his work has directed the growers of organic vegetables in the central cost region of California, towards the range of soil management practices pest management, crop rotation, cover crops, harvest and packing methods used and also the marketing options, state and federal regulations governing organic commodities.

Mishra (1994), said low production and productivity are the core problems of Indian agriculture. Despite substantial increases in the use of modern inputs, the yields are lower than those in advanced countries. Inadequate irrigation facilities; poor manuring practices; and obsolete methods of cultivation are some of the causes. The need to feed a growing population forced the country to increase the use of chemical fertilizers and change the agricultural practices, which are slowly

Mansvelt *et al.* (1993), considered four fundamental aspects in defining sustainability: (1) food security; (2) employment and income generation; (3) environmental and natural resource conservation; and (4) people's participation and empowerment. Priorities may be set in the implementation of these aspects, with different attitudes toward nature, society and ethical decisions. This paper compares basic requirements of sustainable development with features of recent strategies, such as integrated agriculture (integrated pest management and integrated plant nutrition systems) and low external input sustainable agriculture (LEISA). Special attention is given to the principles underlying autonomous ecosystem management, as applied in organic agriculture.

Pimentel (1993) has shown that the organic production of grains such as maize requires less of fossil energy than conventional crop production. Under organic conditions the yield per unit of labour is low than that of conventional (inorganic) system. With fewer fossil energy, other inputs and employing environmentally sound technologies with greater knowledge management strategies, agricultural systems can be made more sustainable.

Reganold *et al.* (1993), opined that biodynamic farming practices and systems show promise in mitigating some of the detrimental effects of chemical-dependent, conventional agriculture on the environment. The physical, biological, and chemical soil properties and economic profitability of adjacent, commercial biodynamic and conventional farms in New Zealand were compared. The biodynamic farms in the study had better soil quality than the neighbouring conventional farms and were just as financially viable on a per hectare basis.

creating problems in Indian agriculture. The component of integrated nutrient supply system suitable for easy adoption include crop rotation, green manures and bio-fertilizers. Effective water saving, equity in water sharing and efficiency in water delivery and use are indispensable for sustainable management of available surface and groundwater resources. There should be an integrated policy for the appropriate use of river, rain, ground, sea and seweage waters. The challenge in tropical and subtropical agriculture is effective control of weeds, insects, pests and pathogens.

Chakraborty *et al.* (1995), have justified the essence of sustainable technology as one which is economically viable, dynamic in nature and adaptable and acceptable to farmers, prevents degradation or excessive loss of soil, water and nutrients and conserves resources for future generation, avoids over exploitation of land with genetic diversity and ecological integrity ensuring good health and vitality of people. The paper also suggests the methods of recycling and utilization of some indigenous low-cost resources supplemented with chemicals and biogenic substances to boost up the yield in different cropping systems taking adequate care to soil health and environmental sanitation.

Smolik *et al.*, (1995) compared the agronomic, economic and ecological performance of alternative (organic) and conventional (inorganic) farming systems and sustainability of various systems was evaluated with regard to soil erosion, pollution potential, whole farm productivity, energy use, environmental stress, economic performance and farm size and concluded that alternative systems was most productive both agronomically and economically and year to

year variability in production was lowest in organic farming system and more sustainable.

Mc Cann *et al.*, (1997), conducted a study on behaviour of farmers practicing organic agriculture and farmers practicing inorganic agriculture, indicated farmers practicing organic agriculture had greater awareness of environmental problems associated with agriculture due to agriculture, crop diversity and multifaceted measure of conservation.

Nguyen (1998), indicated that the use of modern biotechnologies, necessarily does not violate the essence of organic agriculture and the genetically modified plant varieties could be used in cultivation.

METHODOLOGY

CHAPTER III

METHODOLOGY

3.1 Selection of study area

Hiriyur taluk in Chitradurga District was selected as the preliminary survey revealed that there were a good number of farmers practicing organic agriculture both in dry land and irrigated conditions.

3.2 Study area description

Hiriyur taluk is 100 kms from Bangalore, located between $13^0 4'$ and 15^0 North latitude and $76^0 2'$ and $76^0 56'$ east longitude, at 524 Mts elevation from the sea level. Hiriyur taluk receives 534 mm rainfall on 48 rainy days with major portion from southwest monsoon commencing early June and terminating in September. Dry weather prevails throughout the year with a maximum temperature of 36^0C in May and 24^0C in December. The study area comes under the ambit of central dry agroclimatic zone of Karnataka. It has three different types of soils black, red loamy and red lateritic soils (**Table 3.1**).

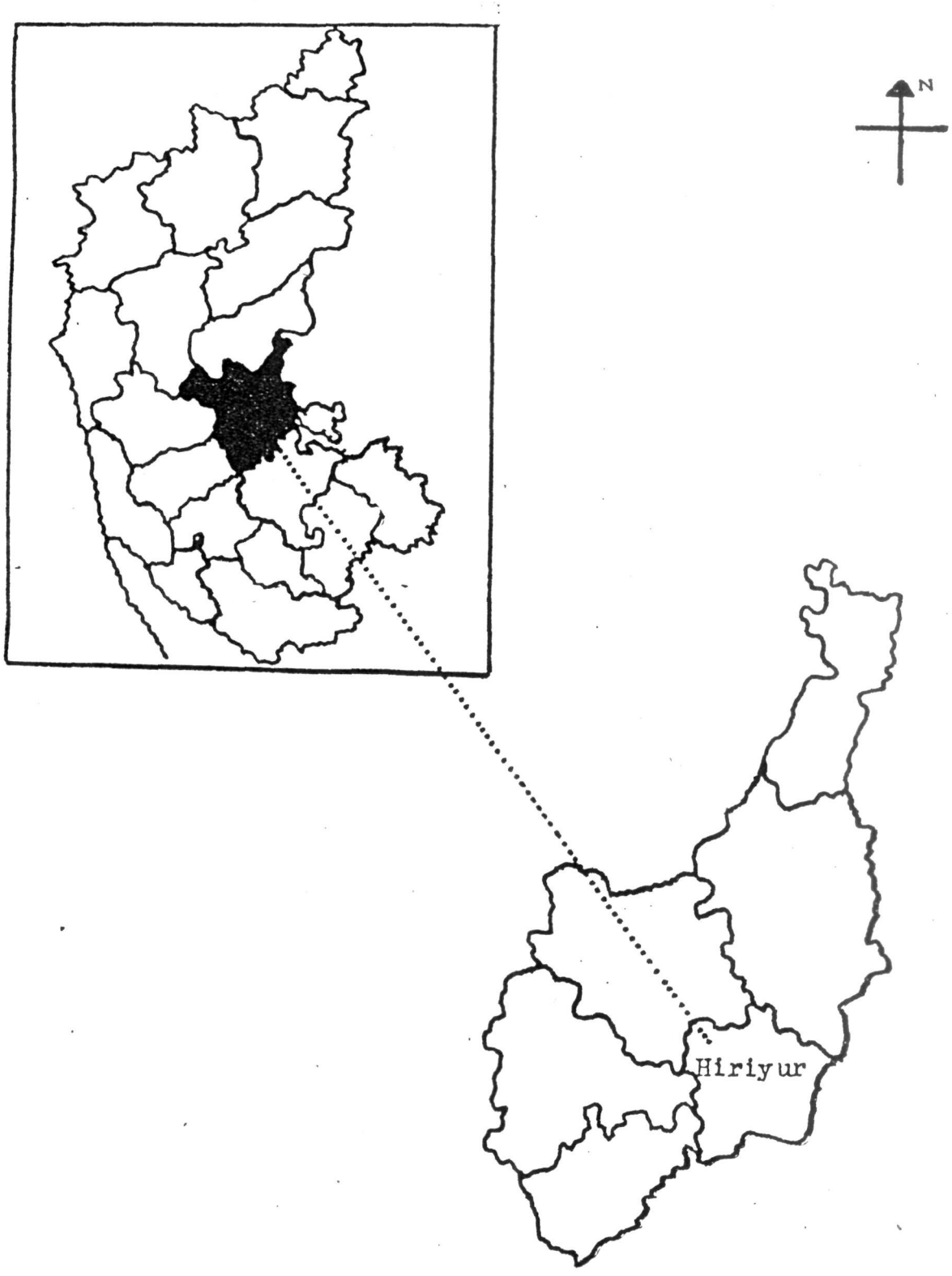
3.3 Sample design and data base

Data on holding size, cropping pattern, cost and returns of various crops and labour use patterns were collected from farmers practicing organic agriculture (FPOA) and farmers practicing

Table 3.1: Irrigated and rainfed areas in Hiriyur taluk

Sl. No.	Particulars	Area(hectares)
1	Geographical area	137423
2	Gross cropped area	53238
3	Net sown area	58990
4	Irrigated area a. Well irrigation - 3280 hectares b. Canal irrigation – 10311 hectares	13950
5	Rainfed area	38049

Fig 1: Map of the study area



inorganic agriculture (FPIA), by personal interview method using pretested schedule designed for the study during 1998. The data pertain to the year 1997-98.

A sample of 32 farmers practicing organic agriculture (FPOA) growing sunflower, groundnut and paddy and 31 farmers practicing inorganic agriculture (FPIA) in these three crops were selected for the study from 18 villages in Hiriyur taluk - Adivala, Adivala farm, Babbur, Babburfarm, Byadarahally, Pitlali, Muskal, MuskalMatti, Ranganathapura, Dharamapura, Hiriyur, Alur, Chillahally, Metikurke, Thooragondanahalli, Errachikkanahalli and Yalagondanahally. The reconnaissance survey indicated that organic farming was popular among large farmers, therefore the sample also included large farmers.

3.4 Empirical framework

Organic farming is a farming method emphasizing the use of organic resources, without the use of agro chemicals, and by adoption of minimum tillage, selective weeding, crop rotation, crop diversification and indigenous and appropriate agricultural knowledge and technology.

Inorganic farming is a method of farming emphasizing on maximizing production through use of external inputs like seeds,

fertilizers, pesticides, herbicides, mechanization and exploitation of ground water and other water sources.

The irrigation water in acre inches is calculated using the formula: Discharge per hour / No. of hours of irrigation.

As the adage, "As you sow, so you reap", seeds are crucial irrespective of the type of farming. Hence, seed is not taken as an independent variable.

3.5 Analytical framework

Analysis of the data was done on the following lines keeping in view the objectives of the study.

1. Economics of cultivation of sunflower, groundnut, paddy on FPOA and FPIA were computed using tabular analysis.
2. Resource productivity and allocative efficiency were analyzed using production function analysis.
3. Labour use pattern in different cultivational operations in the production of sunflower, groundnut and paddy was analyzed using tabular analysis.
4. Partial budgeting technique was used to study the externalities in organic and inorganic farms.

3.5.1 Resource productivity and allocative efficiency

Gross revenue function per farm was estimated separately for three crops to appreciate the factors contributing to gross returns.

For Sunflower, the gross return function estimated was:

$Y = a_1 x_1^{b1} e^{c1x1} x_2^{b2} e^{c2x2} e^{a2d1} e^{c3x3d2}$

The log linear functional form was,

$Ln\ Y = lna_1 + b_1 lnx_1 + c_1 x_1 + b_2 lnx_2 + c_2 x_2 + a_2 d_1 + c_3 x_3 d_2$

where,

Y = Gross returns in rupees per farm.

x_1 = Organic manures in rupees per farm.

x_2 = Expenditure on pesticides in rupees per farm.

x_3 = Expenditure on chemical fertilizers in rupees per farm

d_1 = Intercept dummy variable (1 for FPOA and 0 for FPIA)

d_2 = Slope dummy for chemical fertilizers (0 for FPOA and 1 for FPIA)

$b_1, b_2, a_2, c_1, c_2, c_3$ are the regression coefficients of the respective independent variables.

The marginal product of the inputs was calculated at the geometric mean level of the output and the geometric mean level of the output, and the respective input by using the expression:

Marginal product of $x_i = (b_i/x_i + c_i)Y$ where,

Y= geometric mean of the gross returns

x_i= geometric mean of the i^{th} independent variable

b_i, c_i= regression coefficients of the i^{th} independent variable.

For Groundnut, the estimated production function was:

$$Y = a_1 x_1^{b1} e^{c1x1} e^{c2x2} e^{c3x3} e^{c4x4} e^{c5x5} e^{a2d1} e^{c7x6d2}$$

The log linear functional form was,

$$\text{Ln } Y = \ln a_1 + b_1 \ln x_1 + c_1 x_1 + c_2 x_2 + c_3 x_3 + c_4 x_4 + c_5 x_5 + a_2 d_1 + c_7 x_6 d_2$$

where,

Y= Gross returns in rupees per farm.

x_1= FYM expenditure in rupees per farm

x_2 = Seed cost per farm

x_3 = Expenditure on pesticides per farm

x_4 = total labour cost per farm

x_5 = irrigation cost per farm

x_6 = Expenditure on chemical fertilizers in rupees per farm

d_1 = intercept dummy (1 for FPOA and 0 for FPIA)

d_2 = slope dummy (0 for FPOA and 1 for FPIA)

$b_1, a_2, c_1, c_2, c_3, c_4, c_5, c_6, c_7$ are regression coefficients of the respective independent variables.

The marginal product of the inputs was calculated at the geometric mean level of the output, and the respective inputs by using the formula:

Marginal product of $x_1 = (b_i/x_i + c_i)Y$ where,

Marginal product of x_2, x_3, x_4, $x_5 = c_i * Y$

Y= geometric mean of the gross returns

x_i= geometric mean of the i^{th} independent variable.

b_i, c_i= regression coefficients of the i^{th} independent variable.

For Paddy, the estimated the gross return function was:

$$Y = a_1 x_1^{b1} e^{c1x1} x_2^{b2} x_3^{b3} e^{c3x3} e^{a2d1} e^{c4x4d2}$$

The log linear functional form was,

$$\text{Ln } Y = \ln a + b_1 \ln x_1 + c_1 x_1 + b_2 \ln x_2 + b_3 \ln x_3 + c_3 x_3 + a_2 d_1 + c_4 x_4 d_2$$

where,

Y= Gross returns in rupees per farm

x_1=FYM expenditure in rupees per farm

x_2= Total labour cost per farm

x_3= Irrigation cost per farm

x_4= Expenditure on chemical fertilizers in rupees per farm

d_1= Intercept dummy (1 for FPOA and 0 for FPIA)

d_2= Slope dummy (0 for FPOA and 1 for FPIA)

b_1, b_2, b_3, c_1, c_3, c_4, a_2 are regression coefficients of the respective independent variables.

The marginal product of the inputs was calculated at the geometric mean level of the output and the geometric mean level of the respective input by using the formula:

Marginal product of x_1, $x_3 = (b_i/x_i + c_i)y$ where

Fig 2: Dummy variables used in the study

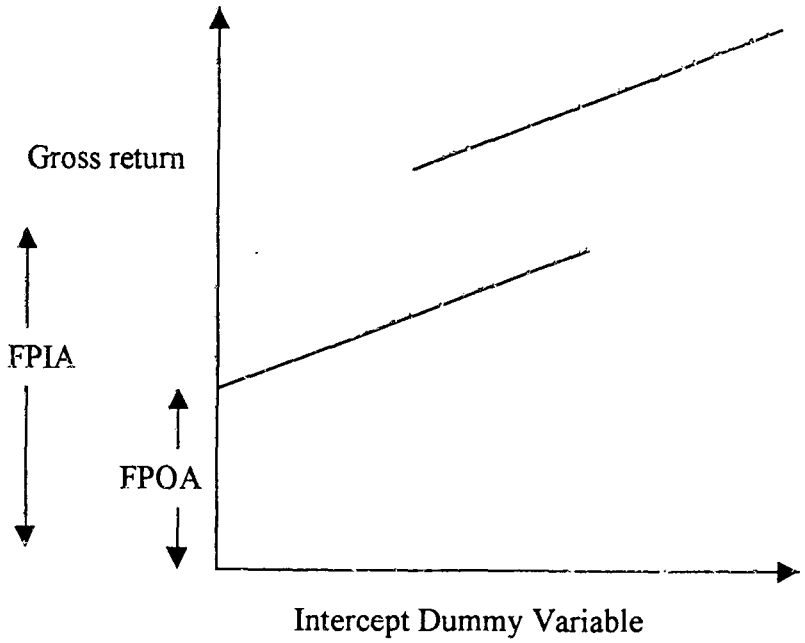


Fig. 2a

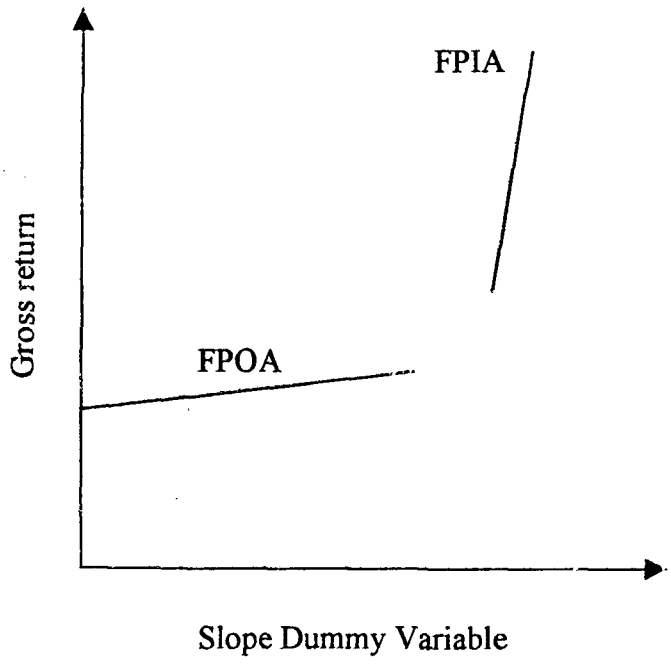


Fig. 2b

Marginal product of $x_2=(b_2/x_2)y$

where,

y= geometric mean of the gross returns

x_i= geometric mean of the i^{th} independent variable

b_i, c_i = Regression coefficients of the i^{th} independent variable.

While the scale for the use of agrochemicals increases because of irrigation facility which is certainly limited in dryland farming. In this study, the farmers of Hiriyur Taluk practicing organic agriculture were growing sunflower in dryland condition, groundnut and paddy under irrigated condition. Though irrigation widens the scope for use of inorganic chemicals the sample farmers (have) preferred to follow the track of organic farming. In order to allow for increasing and decreasing type of returns on organic farms as well as inorganic farms, in the classical production function framework, a modified transcedental production function has been used. The researcher in fact estimated different types of production function namely linear, quadratic, log-log inverse, square root, transcedental and cob-douglas forms, a total number of sixty different combinations of production functions with different inputs was estimated. Among all the input combinations and forms of production function which in fact estimated provided high R^2 and significant coefficients but only the above used forms provided a pragmatic and good fit to the data with economic results.

Use of intercept and slope dummy variables

In the study the intercept dummy variables of one for FPOA and zero for FPIA are introduced for pooled data of FPOA and FPIA (**Fig. 2a**), in order to test the hypothesis that FPIA have higher

starting point when compared with FPOA, but among that the slope remain the same. The use of intercept dummy variable obviously indicates the two forms of production function (one for FPOA with the coefficient of intercept dummy variable and other for FPIA without the coefficient of intercept dummy variable).

The slope dummy variables of one for FPIA and zero for FPOA are introduced in the same production function (**Fig. 2b**) in order to test the hypothesis that the response of gross return to the use of chemical fertilizer by FPIA is higher than the response of gross return to the use of organic manures by FPOA.

3.5.2 Labour use pattern for various operations in the cultivation of sunflower, groundnut and pattern.

The gender wise labour used for different operations and the per cent of woman labour used in different operations to the total labour used was computed, also the percentage to total cost of cultivation was also imputed for each of the three crops.

3.5.3 Assessment of benefits due to use of organic manure

Externality in organic agriculture includes *inter alia* the increased net return due to savings in cost for using chemical fertilizers and plant protection chemicals. The difference in

quantitative aspects of organic agriculture and inorganic agriculture is reflected through partial budgeting technique.

Debit	Credit
Increase in cost due to organic agriculture	Savings due to organic agriculture
Decrease in return due to organic agriculture	Increase in return due to organic agriculture
Total	**Total**

Credit – Debit = Net gain/loss

RESULTS

CHAPTER IV

RESULTS

The number of farmers practicing organic agriculture (FPOA) has increased in the recent years in the study area as awareness among the farmers regarding the ill effects of chemical farming is increasing. The results obtained are presented as below:

4.1 General Information:

The land holding pattern in farmers practicing organic agriculture (FPOA) and farmers practicing inorganic agriculture (FPIA) with respect to rainfed and irrigated land (14.78 acres of rainfed and 24.32 acres of irrigated land in FPOA, and 19.06 acres of rainfed and 25.17 acres of irrigated land in FPIA) are comparable including the source of irrigation as around 50 per cent of the area irrigated in each category was irrigated by groundwater and remaining 50 per cent of land was irrigated by canal. Net irrigated area on FPOA and FPIA are comparable, majority of the farmers could not sow any crop more than once due to paucity of irrigation water and thus the net irrigated area is same as gross irrigated area.

Considering the livestock population, the FPOA had eight cows, four she-buffaloes, four bullocks for draft purpose and 25 sheep where as FPIA had two cows, three buffaloes, one bullock for draft purpose and 9 sheep. This shows the differential potential in the supply of FYM (**Table 4.1**).

Table 4.1: General information

Sl. No.	Particulars	FPOA	FPIA
1	Sample size	32	31
2	Size of holding (acres)		
a	Dry land	14.78 (38%)	19
b	Net irrigated area	24.32 (62%)	25
3	Source of Irrigation (No. of farmers with)		
a	Well Irrigation	17(53%)	13(42%)
b	Canal Irrigation	15(47%)	18(58%)
4	Live stock (numbers)		
a	Cows	8	2
b	She buffaloes	4	3
c	Sheep	25	9
d	Bullocks	4	1

FPOA - farmers practicing organic agriculture
FPIA - farmers practicing inorganic agriculture

Table 4.2 : Cropping pattern (per farm)

Crops	FPOA		FPIA	
	Area (acres)	Percentage to total	Area (acres)	Percentage to total
Irrigated crops				
Paddy	3.9	9.8	4.2	9.4
Coconut	4.4	11.1	3.3	7.3
Arecanut	3.8	9.5	2.4	5.3
Pomegranate		Nil	1.2	2.7
Groundnut	11.3	28.4	12.9	28.7
Fig		Nil	0.7	1.6
Cotton	1.5	3.8	0.9	2.0
Rainfed crops				
Ragi	0.8	2.0	0.5	1.1
Sunflower	12.6	31.6	17	37.9
Jowar	1.8	3.8	1.8	4.0
Total	39.8	100	44.9	100

FPOA - farmers practicing organic agriculture
FPIA - farmers practicing inorganic agriculture
One hectare is equal to 2.5 acres

Fig 5: The coir waste left over after rope making in the background is used as manure

Fig 6: Water storage structure in one of the farms in Hiriyur

4.2 Crop pattern:

The FPOA devoted 20 per cent of the net sown area on plantation crops (coconut 11.1 percent, arecanut 9.5 per cent), 9.8 per cent on food crop (paddy), 28 per cent on oil seed crop (groundnut) and the remaining on commercial crops. FPIA on the other hand devoted 9.4 per cent to paddy, 29 per cent on groundnut and 18 per cent on the commercial crops. The extent of commercialisation on FPOA and FPIA was strong even on the rainfed land, 32 per cent of the area was devoted to the oil seed crop sunflower.

Though FPOA and FPIA had around 50 per cent of net sown area as irrigated, they devoted large proportion of area to light irrigated crops like coconut. This shows that there is positive of water. For FPOA out of the total land holdings 53 per cent was irrigated land and 47 per cent of the land was under rainfed conditions, whereas on FPIA 50 per cent of landholdings was irrigated and remaining 50 per cent was under rainfed conditions. (Table 4.2)

4.3 Costs and returns

The cost and return for sunflower, groundnut and paddy are worked out for farmers practicing organic agriculture (FPOA) and for farmers practicing inorganic agriculture (FPIA) separately

4.3.1 Sunflower:

For FPOA, the expenditure on organic manure was 35 per cent of the cost of cultivation and expenditure on human and bullock labour formed 31 per cent. For FPIA the expenditure on nutrients (manures and fertilizers) formed 39 per cent

of the cost while that on human, bullock and tractor labour formed 27 per cent. Expenditure on plant protection chemicals by FPIA was 70 per cent higher than that by FPOA. The variable costs of FPIA were 53 per cent higher than that of FPOA at Rs. 107664, and so was the cost of cultivation. The gross return of FPOA was 69 per cent lesser than the gross return of FPIA as the yield level of FPOA was low. However, the net return of FPOA were 45 per cent higher than FPIA. The net return per rupee of total cost on FPOA is 0.43 while that on FPIA is 0.13. The net return per rupee of variable cost on FPOA is 0.8 while that on FPIA is 0.3 **(Table 4.3.2)**.

4.3.2 Groundnut:

Considering the cost of cultivation of groundnut on FPOA the cost of organic manure formed 34 per cent of the cost of cultivation followed by labour cost (27 per cent). The cost of production per acre was Rs. 7176 yielding a net return of Rs. 956 per acre on FPOA. Around 40 per cent of organic manure was purchased and 80 per cent of the labour was hired. The FPOA spent five per cent of the cost on biopesticides while the FPIA spent seven per cent of the cost on plant protection chemicals. FPOA realized a net return of Rs. 1969 per acre over variable costs, and reaped a net cost benefit ratio of 0.3 over variable costs.

Considering the FPIA they incurred 36 per cent on fertilizers which is comparable with FPOA expenditure on manures. Though there is little variation in the proportion of total cost spent on nutrients on both the type of farms, the FPOA spent RS 2282 per acre while the FPIA spent 3876 which is 70 per cent higher

Table 4.3.1 : **Input output relationship of sunflower, groundnut, paddy in Hiriyur taluk, 1998 (per acre)**

Sl. No.	Particulars	Sunflower		Groundnut		Paddy	
		FPOA	FPIA	FPOA	FPIA	FPOA	FPIA
1.	FYM (tonnes)	4	1	5	1.5	4	2
2.	Seed (Kgs)	3	4	4	5	8	7
3.	Green manure (bundles)	20	Nil	10	Nil	10	Nil
4.	Tractor labour (hours)	Nil	0.7	Nil	0.9	Nil	1.8
5.	Bullock labour (days)	3.0	2.0	3.0	1.0	5.0	2.0
6.	Man labour (days)	15	19	18	20	12	15
7.	Woman labour (days)	25	14	35	42	31	42
8.	Fertilizer (NPK in Kgs)	Nil	120	Nil	140	Nil	250
9.	Irrigation water (acre inches)	Nil	Nil	15	20	30	35
10.	Yield (quintals)	6	9	6	8	19	26

Note :

FPOA - farmers practicing organic agriculture
FPIA - farmers practicing inorganic agriculture

Table 4.3.2: Cost of cultivation of sunflower in organic and inorganic farms in Hiriyur Taluk, 1998 (in rupees)

Sl No	Particulars	Farmers Practicing Organic Agriculture		Farmers practicing Inorganic Agriculture	
		Per farm	Per acre	Per farm	Per acre
1	Farm Yard Manure	19214(28)	1522	6849(5.5)	403
2	Chemical Fertilizers	Nil	Nil	42555(33.9)	2503
3	Green Manure + Oil cakes	4688(6.9)	375	Nil	Nil
4	Seeds	3156(4.6)	250	4250(3.4)	250
5	Plant protection chemicals	Nil	Nil	10768(8.6)	692
6	Biopesticides	3406(4.9)	270	Nil	Nil
7a	Men labour @ Rs. 40 / day	7400(10.8)	600	11560(9.2)	690
b	Women labour @ Rs. 25 / day	7925(11.6)	625	15350(12.2)	920
c	Bullock labour @ Rs. 150 / day	6150(8.9)	450	4200(3.3)	300
d	Tractor labour @ Rs. 1000 for six hours	Nil	Nil	2840(2.3)	215
8	Interest on working capital @ 12. 5 p.a.	6492(9.5)	512	12297(9.9)	740
A	TOTAL VARIABLE COST	58431	4604	110669	6713
B	FIXED COST				
9	Rental value of land @ 10 % of gross returns	10183(14.8)	807	14706(11.7)	865
C	Cost of cultivation (A+B)	68614(100).	5411	125375(100)	7528
D	Marketing cost	2400	190	4732	278
E	Total cost (C+D)	71014	5601	130107	7806
F	Gross return	101833	8066	147057	8650
G	Net return over total cost	30819	2465	16950	844
H	Net return per rupee of total cost	0.43	0.43	0.13	0.03
I	Net return over variable cost	43402	3462	36388	1937
J	Net return per rupee of variable cost	0.8	0.8	0.3	0.3

Note:

Biopesticides include neem oil, garlic paste solution.
Area under sunflower per farm in FPOA was 12.6 acres, FPIA was 17 acres
Figures in parentheses indicate the percentage of the cost of cultivation

Table 4.3.3: Cost of cultivation of Groundnut in organic and inorganic farms in Hiriyur Taluk, 1998 (in rupees)

Sl. No.	Particulars	Farmers Practicing Organic Agriculture		Farmers practicing Inorganic Agriculture	
		Per farm	Per acre	Per farm	Per acre
1	Farm Yard Manure	18106(22.3)	1605	7382(6.2)	572
2	Chemical Fertilizers	Nil	Nil	42626(36.0)	3304
3	Green Manure + Oil cakes	9447(11.7)	677	Nil	Nil
4	Seeds	4459(5.6)	365	5006(4.2)	388
5	Plant protection chemicals	Nil	Nil	8809(7.4)	720
6	Biopesticides	4072(5.1)	361	Nil	Nil
7a	Man labour @ Rs. 40 / day	8040(10.0)	720	9600(8.1)	800
b	Woman labour @ Rs. 25 / day	9850(12.1)	900	12750(10.7)	1050
c	Bullock labour @ Rs. 150 / day	4200(5.2)	350	2250(1.9)	150
d	Tractor labour @ Rs. 1000 for six hours	Nil	Nil	2800(2.4)	200
8	Irrigation cost	5641(6.7)	500	2666(2.2)	207
9	Interest on working capital @ 12. 5 p.a.	7977(9.8)	685	11736(10.0)	924
A	TOTAL VARIABLE COST (Rs.)	53686	6163	105625	8315
B	FIXED COST				
10	Rental value of land @ 10 % of gross return	9315(11.5)	813	12920(10.9)	1073
C	Cost of cultivation (A+B)	81107(100)	6976	11845(100)	9368
D	Marketing cost	2256	200	3050	236
E	Total cost (C+D)	83363	7176	121595	9574
F	Gross return	93150	8132	129200	10228
G	Net return over total cost	9787	956	7705	654
H	Net return per rupee of total cost	0.13	0.13	0.07	0.07
I	Net return over variable cost	39464	1969	23575	1913
J	Net return per rupee of variable cost	0.7	0.3	0.2	0.2

Note: Biopesticides included Rhizobium culture, Neem Oil, Garlic paste solution. Irrigation cost is valued at the rate of Rs. 211 per acre inch for groundwater irrigated farms and Rs. 24 per crop per acre for canal irrigated farms. FPOA used 15 acre inches, FPIA used 20 acre inches per acre.

Area under groundnut per farm in FPOA was 11.3 acres, FPIA was 12.9 acres

Figures in parentheses indicate the percentage of the cost of cultivation

over FPOA. Similarly, the FPOA spent 50 per cent (Rs351) of the expenditure on plant protection chemicals spent by FPIA (Rs. 720). The labour use on both the types of farmers is comparable. Though the gross returns are 25 per cent lower for FPOA compared to FPIA, the net returns per acre per acre over variable costs are comparable because there is a saving of 26 per cent in cost of cultivation in variable costs for FPOA. In groundnut the woman labour per rupee of gross return is 0.12 womanday for both FPOA and FPIA (**Table 4.3.3**).

4.3.3 Paddy

For FPOA, expenditure on organic manure (nutrients) formed 22 per cent of the cost of cultivation. The expenditure on human and bullock labour formed 32 per cent. For FPIA the expenditure on nutrients (manures and fertilizers) formed 33 per cent of the cost of cultivation. For FPIA the cost of plant protection chemicals was Rs 605 per acre which is 66 per cent higher than the cost of biopesticides for FPOA (Rs. 215, forming four per cent). All the FPOA used bullock labour, while FPIA used both bullock and tractor labour, and thus FPOA saved substantially. The use of woman labour per rupee of gross return is 0.3 woman day in FPOA, 0.38 woman day per rupee of gross return in FPIA, but in the case of sunflower the woman labour per rupee of gross return is 0.1 womanday for both FPOA and FPIA. Though the net return are comparable, the net return per rupee of variable cost is higher for FPOA by 40 per cent over FPIA. The net return per rupee of variable cost for FPOA is 0.79 while that for FPIA is 0.48

Table 4.3.4: Cost of cultivation of Paddy in organic and inorganic farms in Hiriyur Taluk, 1998 (in rupees)

Sl. No.	Particulars	Farmers practicing organic agriculture		Farmers practicing Inorganic agriculture	
		Per Farm	Per acre	Per Farm	Per acre
1	FYM	4028(17.0)	1015	2406(6.7)	712
2	Fertilizers	Nil	Nil	9316(26)	2083
3	Other Organic manure	1146(4.8)	289	Nil	Nil
4	Seeds	1339(5.7)	337	1623(4.5)	439
5	Plant protection chemicals	852(3.6)	215	2535(7.1)	605
6	Biopesticides				
7a	Man labour @ Rs. 40 / day	1820(7.7)	440	2440(6.9)	600
b	Woman labour @ Rs. 25 / day	2900(12.3)	700	4450(12.3)	1050
c	Bullock labour @ Rs. 150 / day	2800(11.9)	750	1350(3.8)	300
d	Tractor labour @Rs. 1000 for six hours	Nil	Nil	1000(2.8)	230
8	Irrigation cost	2778(11.8)	700	2603(7.2)	621
9	Interest on working capital @ 12. 5 p.a.	2208(9.5)	556	3465(9.6)	830
A	TOTAL VARIABLE COST	19871	5002	31188	7470
B	FIXED COST				
10	Rental value of land @ 10 % of gross returns	3693(15.7)	895	4724(13.1)	1109
C	Cost of cultivation (A+B)	23564(100)	5897	35912(100)	8579
D	Marketing cost	725	183	1300	311
E	Total cost (C+D)	24289	6080	37212	8890
F	Gross return	36933	8950	47235	11090
G	Net return over total cost	12644	2870	10023	2200
H	Net return per rupee of Total cost	0.5	0.5	0.3	0.3
I	Net return over variable cost	17062	8950	16047	11090
J	Net return per rupee of variable cost	0.9	1.8	0.5	1.5

Note: Biopesticidal formulations included juice of *Agave sisalana* (Kattale) added in the irrigation source, to avoid breeding of pests in paddy fields. Garlic oil was also used. FPOA used 30 acre inches of water while, FPIA used 35 acre inches of water per acre for irrigation from various sources.

Area under paddy per farm in FPOA was 3.9 acres, FPIA was 4.2 acres

Figures in parentheses indicate the percentage of the cost of cultivation

This shows that FPOA are reaping economic profits in the cultivation of all the three crops due to savings in variable costs in FPOA. Thus FPOA are following costs savings technologies while FPIA are following yield augmenting technologies **(Table 4.3.4)**.

The input output relationship for FPOA and FPIA for all the three crops were tablulated **(Table 4.3.1)** which indicated that use of FYM by FPOA was same for all the three crops (around 5 tonnes), the FYM used by FPIA was lower which was compensated by use of fertilizers NPK (120 kgs for sunflower, 140 kgs for groundnut and 250 kgs in paddy per acre). The irrigation water used was lower by FPOA compared to FPIA, the yield level for both FPOA and FPIA were comparable (FPIA with slightly higher yield).

4.4 Resource productivity and allocative efficiency

Production function of the log linear type with slope and intercept dummy variables was estimated for each of the three crops to analyze the relationship between the gross return and input cost. An intercept dummy variable for differentiating FPOA and FPIA was used. Another dummy variable to differentiate between farmers using fertilizers and organic manure was used as a slope dummy variable.

4.4.1 Sunflower

The intercept dummy variable introduced to capture the overall difference in the input use and gross return levels between farmers practicing organic

agriculture (FPOA) and farmers practicing inorganic agriculture (FPIA) was -1.184 and was statistically significant. This indicated that these two types of farmers significantly differed with regard to the factors not considered in the production function for FPOA and FPIA. Nevertheless, since the value of −1.184 is not economically significant this difference is too small to be ignored. The slope dummy coefficient was a meager 0.0000029 (**Table 4.4.1**) and was statistically insignificant indicating that even though the overall difference between the FPOA and FPIA was statistically significant, the use of fertilizers by FPIA did not make any significant contribution to the gross return. Thus, application of organic manure will not in any way preclude the performance of gross return in the cultivation of sunflower. This is a crucial lesson for those farmers who have apprehension regarding the use of organic manure in sunflower cultivation. The production function analysis indicated that the marginal productivity of the 15511th Re. of organic manurial input added Rs. 8.73 to the gross income of sunflower, keeping all other input use at their respective geometric mean level. The elasticity of production of organic manure was 0.83 indicating that for a one percent increase in the use of organic manure input, the gross income increased by 0.83 per cent. The elasticity of production of PPC was relatively low (0.09) and statistically insignificant. For FPOA this shows that organic manure provides a congenial plant micro climatic environment which will strengthen the soil and the crop to fight pests and diseases (**Table 4.4.1a**).

Table 4.4.1: Resource productivity in sunflower, Hiriyur taluk, 1998

Variable	Coefficients	t ratio
Logarithm of intercept	3.65	5.314
Logarithm of cost of organic manure (Rs)	0.825	7.588
Cost of organic manure (Rs)	0.00000	0.3452
Logarithm of cost of pesticide (Rs)	0.0907	0.8636
Cost of pesticide cost (Rs)	-0.00000	-0.37105
Intercept dummy (1 for FPOA and 0 for FPIA)	-1.184	-4.922
Slope dummy for use of chemical fertilizers (0 for FPOA and 1 for FPIA)	0.00000	1.165

Table 4.4.1a: Allocative efficiency in sunflower, Hiriyur taluk, 1998

Variable	Geometric mean (Rs.)	Elasticity of production	MVP	MFC	MVP:MFC
Cost of organic manure	15511	0.92	8.73	1	8.73
Cost of pesticides	7521	0.07	1.46	1	1.46

Note:

Sample size is 63

Dependent variable is gross return in rupees per farm

Coefficient of multiple determination is 0.94

Average area under sunflower per farm among FPOA was 12.6 acres, FPIA was 17 acres

4.4.2 Groundnut:

Given the fact that both FPOA and FPIA are using a yielding varieties and have comparable holding size and irrigation facilities to capture other difference between FPOA and FPIA if any. This coefficient (of -1.45) was statistically significant. A slope dummy was used further, to differentiate between FPIA (using chemical fertilizers) and FPOA resulted in another coefficient of value -0.0000074 **(Table 4.4.2)** statistically significant. Though this is statistically significant its value is of poor economic significance and thus, leads to conclusion that use of chemical fertilizers by FPOA does not place them on a higher plateau with regard to gross return, when compared with FPOA who intend use of organic manure. The contribution of 16712^{th} rupee spent on organic manure was Rs. 5.16 to the gross return and is statistically significant. The contribution of seed to gross returns is high at Rs. 7.7 (for the 4729^{th} rupee spent). Though the labour, plant protection chemicals and irrigation are crucial factors, their contribution is masked by organic manure. Results indicate that these three factors are statistically non-significant .The contribution of 4366^{th} rupee spent on irrigation to the gross returns is Rs. four. The coefficient of multiple determination is 0.97. The elasticity of production of organic manure was high at 0.69 **(Table 4.4.2a)**.

4.4.3 Paddy

The production function analysis indicated that the elasticity of production was 0.55 for labour cost, 0.24 for the cost of organic manure. Though the slope dummy for use of chemical fertilizer by FPIA was significant, the coefficient was a

Table 4.4.2: Resource productivity in groundnut, Hiriyur taluk, 1998

Variable	Coefficients	t ratio
Logarithm of intercept	3.49	9.203
Logarithm of cost of organic manure (Rs)	0.9187	18.152
Cost of organic manure (Rs)	-0.00002	-2.706
Seed cost (Rs)	0.00009	2.14
Cost of pesticide (Rs)	-0.000005	-0.408
Total labour cost(Rs)	-0.000006	-0.571
Cost of irrigation (Rs)	0.00005	1.54
Intercept dummy (1 for FPOA and 0 for FPIA)	-1.45	-15.327
Slope dummy for use of chemical fertilizers (0 for FPOA and 1 for FPIA)	-0.0000074	-2.14

Table 4.4.2a: Allocative efficiency in groundnut, Hiriyur taluk, 1998

Variable	Geometric mean (Rs.)	Elasticity of production	MVP	MFC	MVP:MFC
Cost of organic manure	16712	0.69	5.16	1	5.16
Cost of pesticides	6895	-0.034	-0.39	1	-0.39
Seed cost	4729	0.46	7.72	1	7.72
Total labour cost	24200	-0.143	-0.465	1	-0.465
Irrigation cost	4366	0.28	4.099	1	4.099

Note:

Sample size is 63
Dependent variable is gross returns in rupees
Coefficient of multiple determination is 0.97
Average area under sunflower per farm among FPOA was 11.3 acres, FPIA was 12.9 acres
Irrigation cost was tabulated as variable cost (Rs. 211 for those with groundwater irrigation and Rs. 24 for those with surface water irrigation).

Table 4.4.3: Resource productivity in paddy, Hiriyur taluk, 1998

Variable	Coefficients	t ratio
Logarithm of intercept	4.32	13.452
Logarithm of cost of organic manure (Rs)	0.256	2.886
Cost of organic manure (Rs)	-0.00000	-0.307
Logarithm of labour cost (Rs)	0.554	6.53
Logarithm of irrigation cost	0.0244	0.72
Irrigation cost (Rs)	-0.00000	-0.0676
Intercept dummy (1 for FPOA and 0 for FPIA)	-1.176	-8.3025
Slope dummy for use of chemical fertilizers (0 for FPOA and 1 for FPIA)	0.00001	3.767

Table 4.4.3a: Allocative efficiency in paddy, Hiriyur taluk, 1998

Variable	Geometric mean (Rs.)	Elasticity of production	MVP	MFC	MVP:MFC
Cost of organic manure	4304.8	0.24	2.31	1	2.31
Labour cost	6859	0.55	6.74	1	6.74
Irrigation cost	2692.1	0.021	0.35	1	0.35

Note:

Sample size is 63
Dependent variable is gross returns in rupees
Coefficient of multiple determination is 0.98
Irrigation cost is taken as Rs. 211 for farmers using groundwater for irrigation, Rs.35 for farmers using surface water for irrigation.

meager 0.000014 (**Table 4.4.3**). Though this statistically significant its value is of poor economic significance and thus, leads to the conclusion that use of chemical fertilizers by FPIA does not place them on a higher plateau with regard to gross return. Similarly in the case of intercept dummy the coefficient was negative (-1.176), which is significant statistically but not economically significant. The marginal return for 4305th rupee spent on organic manure was Rs. 2.31, the marginal return for 8075th rupee spent on labour was 6.71. The contribution of 2692nd rupee spent on irrigation was 0.35 (**Table 4.4.3a**).

4.5 Labour used in the cultivation of sunflower, groundnut and paddy:

4.5.1 Sunflower

For FPOA 63 per cent of the total labour are woman labour claiming 52 per cent of the wage bill. Major portion of the woman labour employed is for weeding (25 per cent) which formed 21 per cent of the wage bill. For harvesting, 24 per cent of the woman labour is employed, which formed 20 per cent of the wage bill (122 woman days per farm and 10 woman days per acre). Thirteen per cent of woman labour is used for fertilizer and manure application and this formed 10 per cent of wage bill (63 woman days per farm and 5 woman days per acre), 1.1 per cent of woman labour is used for application of plant protection chemicals (bio pesticides) and formed 0.9 per cent of the wage bill (6 woman days per farm and 1 woman day per acre),

For FPIA, 68 per cent of the total labour is woman labour forming 57 per cent of the wage bill. Major portion of the woman labour is employed for

Table 4.5.1: Labour use in sunflower cultivation (per farm), Hiriyur taluk, 1998

Sl. No.	Practice	Farmers practicing organic agriculture (for 12.6 acres per farm)						Farmers practicing Inorganic agriculture (for 17.0 acres per farm)					
		Mandays	Value (Rs.)	Woman days	Value (Rs)	Womanlabour		Mandays	Value (Rs.)	Woman days	Value (Rs.)	Womanlabour	
						As % of total labour days	As % of total labour cost					As % of total labour days	As % of total labour cost
1	Land preparation	63(5)	2520(200)	0	0	0	0	119(7)	4760(280)	0	0	0	0
2	Fert. and manure appln	25(2)	1000(80)	63(5)	1575(125)	12.5	10.3	28(2)	1040(80)	117(7)	2925(175)	12.9	10.9
3	weeding	50(4)	2040(160)	126(10)	3150(250)	25.1	20.6	56(3)	2240(120)	237(14)	5925(350)	26.2	22
4	Plant protection	13(1)	520(40)	6(1)	150(25)	1.1	0.9	26(2)	1040(80)	13(1)	325(25)	1.5	1.2
5	Harvesting	34(3)	1360(120)	122(10)	3050(250)	24.3	19.9	59(3)	2320(120)	247(15)	6175(375)	27.4	22.9
6	Total	185(15)	7400(600)	317(25)	7925(625)	63	51.7	289(17)	11560(680)	614(36)	15350(900)	68	57

NOTE:

Per acre figures are in parentheses.
Wages Rs. 40.00 per man day and Rs. 25.00 per woman day

harvesting (27per cent) which formed 23 per cent of the wage bill (247 woman days per farm and 15 woman days per acre). For weeding 26 per cent of the labour were woman and formed 22 per cent of the wage bill (237 woman days per farm and 14 woman days per acre). For manure and fertilizer application woman labour use is 13 per cent out of the total labour which formed 11 per cent of the wage bill (117 woman days per farm and 7 woman days per acre) (**Table 4.5.1**).

4.5.2 Groundnut

For FPOA, the women labour formed 70 per cent of the total labour and 55 per cent of the wage bill, whereas on FPIA the women labour was 67 per cent of the total labour forming 56 per cent of the wage bill. For harvesting 30 per cent of woman labour was used and formed 25 per cent of the wage bill for FPOA, similarly for FPIA 26 per cent of the women labour were employed in harvesting. Both for FPOA and FPIA around 25 per cent of the woman labour are employed in weeding forming 22 per cent of the wage bill. The contribution of woman labour in other cultivation practices is meager (**Table 4.5.2**).

4.5.3 Paddy

The requirement of woman labour is usually high for cultivation of paddy, the various operations in which woman labour are employed are transplanting, weeding and harvesting. Usually woman labour is used where there is lot of bending activity like transplanting, weeding, harvesting. Man labour is usually employed where they perform non-bending operations like ploughing etc. For

Table 4.5.2: Labour use in groundnut cultivation (per farm), Hiriyur taluk, 1998

Sl. No.	Practice	Farmers practicing organic agriculture (for 11.3 acres per farm)						Farmers practicing Inorganic agriculture (for 12.9 acres per farm)					
		Mandays	Value (Rs.)	Woman Days	Value (Rs)	Womanlabour		Mandays	Value (Rs.)	Woman days	Value (Rs.)	Womanlabour	
						As % of total labour days	As % of total labour cost					As % of total labour days	As % of total labour cost
1	Land preparation	64(6)	2560(240)	0	0	0	0	74(6)	2960(240)	0	0	0	0
2	Fert. and manure appln	34(3)	1520(120)	56(5)	1400(125)	9.4	7.8	52(4)	2080(160)	103(8)	2575(200)	12.8	10.7
3	Weeding	64(6)	2160(240)	158(14)	3950(350)	26.5	22	73(6)	2920(240)	205(16)	5125(400)	25.4	21.3
4	Plant protection	15(1)	600(40)	23(2)	575(50)	3.9	3.2	13(1)	520(40)	26(2)	650(50)	3.1	2.4
5	Harvesting	72(7)	2880(280)	181(16)	4525(400)	30.4	25.3	52(4)	2080(160)	206(16)	5150(400)	25.7	21.6
6	Total	201(18)	8040(720)	418(37)	9875(925)	70.2	55.1	262(20)	10480(800)	541(42)	13525(1050)	67.2	56.3

NOTE:

Per acre figures are in parentheses.
Wages Rs. 40.00 per man day and Rs. 25.00 per woman day

Table 4.5.3: Labour use in paddy cultivation (per farm), Hiriyur taluk, 1998

Sl. No.	Practice	Farmers practicing organic agriculture (for 3.9 acres per farm)						Farmers practicing Inorganic agriculture (for 4.2 acres per farm)					
		Mandays	Value (Rs.)	Woman days	Value (Rs)	Womanlabour		Mandays	Value (Rs.)	Woman days	Value (Rs.)	Womanlabour	
						As % of total labour days	As % of total labour cost					As % of total labour days	As % of total labour cost
1	Land preparation	16(4)	640(160)	0	0	0	0	27(7)	1080(175)	0	0	0	0
2	Fert. and manure appln.	9(2)	360(80)	4(1)	100(25)	2.5	2.1	10(2)	400(50)	5(1)	125(25)	2.1	1.8
3	Transplanting	6(1)	240(40)	36(9)	900(225)	22.3	19.1	9(2)	360(50)	55(10)	1375(275)	23	20
4	Weeding and plant prot.	7(2)	280(80)	36(8)	900(320)	22.3	19.1	6(2)	240(50)	52(12)	1300(300)	21.7	18.8
5	Harvesting	8(2)	320(80)	39(10)	975(400)	24.2	20.6	9(2)	360(50)	66(16)	1650(400)	27.6	24
6	Total	46(11)	1840(440)	115(28)	2875(1120)	71.4	61	61(15)	2440(375)	178(40)	4450(1000)	74.4	64.5

NOTE:

Per acre figures are in parentheses.
Wages Rs. 40.00 per man day and Rs. 25.00 per woman day

FPOA 71 per cent of the total labour employed were woman forming 61 per cent of the wage bill which is on par with FPIA. Both for FPOA and FPIA 23 per cent of woman labour out of total labour are employed in transplanting forming about 20 per cent of the wage bill. For weeding 22 per cent of woman labour were employed forming 19 per cent of the wage bill both for FPOA and FPIA. Harvesting required more labour in both FPOA and FPIA, for FPOA 24 per cent of the woman labour was used which formed 21 per cent of the wage bill and on FPIA 28 per cent of woman labour are employed in harvesting, forming 24 per cent of the wage bill (**Table 4.5.3**).

Table 4.6.1 : Partial budgeting to evaluate organic farming practice, in sunflower, Hiriyur taluk, 1998 (in rupees per acre)

Costs			Returns		
Increase in cost due to organic agriculture			Savings in costs due to organic agriculture		
a) Cost of FYM	=	1119	a) Cost of PPC	=	692
b) Oil cakes, green manure	=	375	b) Cost of fertilizers	=	2503
c) Biopesticides	=	270	c) Labour	=	2125
d) Labour	=	1675			
Decrease in return	=	584	Increase in return	=	0
Total A	=	**4023**	**B**	=	**5320**
B – A	=	**1297**			

Note:

Increase in cost due to organic agriculture is the sum of difference between cost of FYM used by FPOA and FPIA, cost of biopesticides, expenditure on green manure, oil cake and labour cost. The FPIA did not use biopesticides, green manure and oil cake.

Savings due to organic agriculture is the sum of cost saved due to reduction in cost of fertilizer and labour cost.

Decrease in returns due to organic agriculture is the difference in the gross returns obtained by FPIA and FPOA.

Table 4.6.2 : **Partial budgeting to evaluate organic farming practice, in groundnut, Hiriyur taluk, 1998 (in rupees per acre)**

Costs			Returns		
Increase in costs due to organic agriculture			Savings in costs due to organic agriculture		
a) Cost of FYM	=	1033	a) Cost of PPC	=	720
b) Oil cakes, green manure	=	677	b) Cost of fertilizers	=	3304
c) Biopesticides	=	361	c) Labour	=	2200
d) Labour	=	1970			
Decrease in return	=	2096	Increase in return	=	0
Total A	=	**6137**	**B**	=	**6224**
B – A	=	**87**			

Note:

Increase in cost due to organic agriculture is the sum of difference between cost of FYM used by FPOA and FPIA, cost of biopesticides, expenditure on green manure, oil cake and labour cost. The FPIA did not use biopesticides, green manure and oil cake.

Savings due to organic agriculture is the sum of cost saved due to reduction in cost of fertilizer and labour cost.

Decrease in returns due to organic agriculture is the difference in the gross returns obtained by FPIA and FPOA.

Table 4.6.3 : Partial budgeting to evaluate organic farming practice, in paddy, Hiriyur taluk, 1998 (in rupees per acre)

Costs			Returns		
Increase in costs due to organic agriculture			Decrease in costs due to organic agriculture		
a) Cost of FYM	=	303	a) Cost of PPC	=	605
b) Oil cakes, green manure	=	289	b) Cost of fertilizers	=	2083
c) Biopesticides	=	215	c) Labour	=	2180
d) Labour	=	1890			
Decrease in return	=	2140	Increase in return	=	0
Total A	=	**4837**	**B**	=	**4868**
B - A	=	**31**			

Note:

Increase in cost due to organic agriculture is the sum of difference between cost of FYM used by FPOA and FPIA, cost of biopesticides, expenditure on green manure, oil cake and labour cost. The FPIA did not use biopesticides, green manure and oil cake.

Savings due to organic agriculture is the sum of cost saved due to reduction in cost of fertilizer and labour cost.

Decrease in returns due to organic agriculture is the difference in the gross returns obtained by FPIA and FPOA.

DISCUSSION

CHAPTER V

DISCUSSION

Organic farming was the convention and the way of life of the vast majority of the farmers in India, till the advent of the green revolution technology. It took a great deal of effort from the agricultural extension personnel to break the inertia of organic farming practices followed by farmers to convince them to take to modern – inorganic fertilizer – chemical pesticide – irrigation responsive – green revolution technologies. To appreciate the efforts of the extension personnel in this regard, the following example is a testimony. Farmers in the then Cholanayakanahalli in proximity of Agriculture College, Hebbal, Bangalore, during 1973[1], were strictly following organic farming techniques. When the students of Agriculture college interviewed them in the Agriculture extension class work, regarding their non acceptance of chemical fertilizers, farmers used to mention that their crops would be burnt if they applied chemical fertilizers. Later, as the new seed varieties responded to fertilizers and irrigation, the demand for chemical fertilizers grew by leaps and bounds. The efforts of agricultural extension workers in diffusion of innovation are remarkable. As the country did not have the domestic capacity to manufacture chemical fertilizers, their supplies were rationed (by providing passbooks to farmers). However, once the farmers realized the short term benefits of high fertilizer responsiveness of new seed varieties, they began demanding the chemical fertilizers and the demand for organic sources of manures such as farm

[1] Discussions with MG Chandrakanth, B.Sc. (Agri) graduate of 1970 -1974 batch of the UAS, Bangalore, on Oct 15, 1999.

yard manure, compost, green manure and tank silt drastically reduced at least in the plains.

The short term varietal response to chemical fertilizers was necessary for bridging the gap between the differential growth rate of population and food production in India, the former surpassing the later. This did result in self sufficiency in food grains during the 1980s, and except in Bihar and Orissa, 80 per cent of households in the country started getting two meals a day. Thus the physical access to food increased as the per capita net availability of food grains increased from 395 grams per day per head in 1951 to 499 grams per day per head in 1999. In addition, the economic access to food also increased. For instance, between 1970 and 1980, the per capita incomes increased by 147 per cent while the food grain prices increased by 124 per cent. Also, the proportion of income spent on food has reduced from 12.9 per cent of the per capita income (to buy a quintal of wheat) in 1970 to only 7 per cent of the per capita income in 1980, thus increasing the purchasing power of people to buy capital goods.

Currently, 83 per cent of the area under wheat and 57 per cent of the area under paddy are under high yielding varieties. About 47 per cent of the area under irrigation is irrigated by groundwater (wells) and 38 per cent of the area is irrigated by the canal irrigation system. High yielding varieties and their need for increased moisture levels, have resulted in increasing the level of use of chemical fertilizers. The level of use of chemical fertilizers has increased from 7.4 kgs per hectare in 1966 to 57 kgs per hectare in 1986, registering an increase of 40 per cent per year.

The philip given to groundwater irrigation not only increased productivity of food grains, but also diversified farming to include a range of enterprises.

Our price policy, buffer stock policy and the food distribution system have provided models for mitigating famines. For instance, the Great Bengal Famine (of 1943) took the lives of 1.5 million people who died of starvation. Now we do not hear of starvation deaths, though India suffered another great famine in 1987 as the food production reached a trough of 114 million tones, the country did not feel the pinch of this food famine. This achievement was due to the sound procurement, buffer stock and PDS (Public Distribution System) policies[2]. Several anti-poverty programs notably the Integrated Rural Development Program, the National Rural Employment Program and the Rural Landless Employment Guarantee Program have helped the rural people to grow above the poverty line. They also helped to improve their bargaining power to seek better wages in the rural areas.

Enterprises like Mulberry-sericulture and dairying improved the economic well being of the farmers and helped in efficiently utilizing the unemployed and underemployed rural family labour force. NABARD's 60 per cent of the refinance was devoted to minor irrigation (groundwater wells) since the 1970s. This philip to groundwater use increased both the productivity of food grains and also helped to diversify farm enterprises.

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[2] About 12 per cent of the food grains produced is procured every year and distributed through 3,21,000 fair price shops all over the country with each fair price shop covering a radius of 13 square kilometers serving 2,500 persons. About 2,50,000 shops are in the rural areas and the remaining are in the urban areas. The price policy helped in stabilizing the prices of essential goods, equitable distribution of essential goods and providing essential items to the target population.

This overall achievement on the food front has fairly disproved the Malthusianists worry that while population increases in geometric progression; food production increases in arithmetic progression. In India, the food production has been growing grown at a higher rate (3.03 per cent) than the population (of 2.2 per cent).

The growth in food production to surpass that of population was a necessary condition for self-reliance and self-sufficiency in India. The sufficient condition is that the growth in food production be sustainable and equitable with bearable transaction costs involved in this process. The achievements on the food front and agro-economic front has been with the transaction costs of loss of diversity of native crop varieties and livestock breeds, emphasis on use of external inputs (like fertilizer, agrochemicals, groundwater from deep wells) and development of varieties which respond to them, resource degradation of land, soil, and over exploitation of forests, surface water, groundwater and the environment. Godwilling, this predicament has surfaced within a generation of twenty-five years so that farmers, researchers and policy makers have breathing time to think about them, analyze and search for solutions.

The prima facie evidence of unsustainable practices of inorganic agriculture is the (i) quick resurgence of major pests and (ii) fast changing plant varieties to suit to the new set of pests, diseases and other disorders. Thus, integrated management of pests and nutrient application has evolved for many crops. In some parts of Karnataka, farmers practice organic agriculture especially where there has

been good rainfall supporting perennial crops (like arecanut (*Areca catechu*)). Here farmers use organic manure and green manure as sources of nutrients, and organic methods of plant protection. These farmers are realizing economically remunerative returns to organic farming practices. Hence, further research to analyze the reasons for response to organic farming practices for such crops is not of great significance for application of organic farming practices on the vast tracts of rainfed agriculture in Karnataka, which covers 80 per cent of the net area sown. Thus, what is of relevance is the economics of organic farming practices for field crops in dry land areas and the benefits and costs of these practices. With this backdrop this study was conducted.

As inorganic agriculture has virtually made inroads in several crops in Karnataka, due to its quick responding attributes the search of sample area and sample farmers practicing organic agriculture, that too for field crops was a difficult endeavour. From the field experience, Professor MA Narayana Reddy, Department of Horticulture, UAS, GKVK, indicated that in Hiriyur taluk, he has knowledge of farmers who are practicing organic agriculture for field crops like paddy and groundnut. Thus, Hiriyur taluk was selected as the sample area.

Cultivation of crops using inorganic fertilizers has now become a convention where use of organic manures was a rule rather than an exception. Thus, organic farming is now treated as non-conventional farming, like use of solar energy, which was the convention, since ages has become a non-conventional source. In Hiriyur taluk the list of farmers following organic agriculture (obtained

from the Agricultural Assistant) covered names of 32 farmers spread over in eighteen villages. If organic farming were to be popular, most of them would be traceable in one or a few villages. This itself is an indicator of how fast inorganic farming has made inroads in Indian agriculture. A large number of these farmers belong to Gounder community from Tamilnadu, who migrated to Hiriyur taluk during 1902, in search of labour wage for the construction of Vani Vilas Sagar dam. These farmers have now integrated with the local communities. For contrast, 31 farmers practicing inorganic agriculture located in proximity of farmers practicing organic agriculture formed the control group.

A third of the sample farmers practicing organic agriculture in Hiriyur taluk indicated that they have been following these practices since long, while the rest indicated that they have been following these practices since the past five years. However, if the definition of organic farming, is strictly based on the variety used by the farmers, then there are no compelling reasons to believe that there is any practicing organic farmer, as all of the farmers are using "improved" varieties, and at present, "local" varieties are difficult to be traced due to advent of improved varieties responsive to chemical fertilizers and irrigation. This compromise on the practice of organic farming has turned out to be a necessary evil.

Considering the field crops grown by these farmers namely sunflower, groundnut and paddy, sunflower is a recent introduction. In addition, sunflower is a highly cross-pollinated crop. Thus, there cannot be a 'local' variety in sunflower. Thus, whether it is FPOA or FPIA, both groups must be using improved (i.e. high

yielding and/or hybrid) varieties of sunflower. As 'seed' is a crucial component in the practice of organic and inorganic agriculture, since both groups are using improved varieties, comparisons between the groups are tenable.

In the case of the highly self pollinated (oilseed) groundnut crop as well as the highly self pollinated (cereal) paddy, at present, strictly 'local' varieties are hardly cultivated by the farmers since 'local' varieties cannot be easily found due to the fact that more than 80 per cent of the farmers are using high yielding/hybrid varieties in Hiriyur taluk. In contrast, in the western ghat and Malnad regions many farmers practicing organic agriculture who are using strictly 'local' varieties of crops like paddy can be traced[3]. In this study, sample farmers following organic agriculture and the sample farmers practicing inorganic agriculture are both cultivating improved varieties of (sunflower, groundnut and paddy) crops for large scale cultivation, and for their household needs are cultivating local variety of paddy by name "Doddabyranellu" on a small area of around half an acre. Even though the farmers are not cultivating "local" varieties on a large scale, the academic strength to this research study is that, since both FPOA and FPIA are both cultivating high yielding varieties, using organic farming practices and inorganic farming practices respectively, their economic performance can be compared. In this process if the hypothesis that FPOA are realizing higher net returns when compared with FPIA is proved, that provides a relatively strong basis for policy implication for revival of organic farming leading to both eco-friendly farming and econ-friendly farming. While eco-friendly farming implies low external

input sustainable agriculture, econ-friendly farming implies relatively higher net returns per rupee of expenditure.

The size of holding of farmers practicing organic agriculture (FPOA) was 14.78 acres of dry land and 24.32 acres of irrigated land. The farmers practicing inorganic agriculture (FPIA) had 19.06 acres of dry land and 25.17 acres of irrigated land per capita. Thus none of the sample farmers practicing organic agriculture were 'small or marginal' farmers. Hence broad comparisons across farm size and on per acre basis can be made. Since small farmers could be located with relative ease in the case of FPIA, and not in FPOA, there are no compelling reasons to believe that organic farming practices at present are amenable for application by small farmers. In this context, the output per unit of nutrients and per unit volume of water, and output per rupee of input realized by FPOA and FPIA are pertinent (**Table 4.1**).

In FPOA, about 38 per cent of the net area sown is dry land and 62 per cent is irrigated. In FPIA, 43 per cent of net area sown is dry land and 57 per cent is irrigated. Thus, both groups had around 60 per cent of the net area sown under irrigation, which implies that organic farming in Hiriyur taluk survives better under irrigation. If FPOA were to be largely following organic farming with little or no irrigation, on their dry lands, then the link between organic farming and rainfed land would have been stronger. Thus, in Hiriyur taluk, farmers practicing organic

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[3] I thank Dr TN Prakash, Associate Professor, Dept of Agricultural Economics, UAS, Bangalore profusely for generating discussion in this context

agriculture, invariably depend on irrigation to a large extent. The source of irrigation is examined next (**Table 4.2**).

Source of irrigation

Irrigation wells and canals were the major sources of irrigation. Both wells which provide groundwater and canals which provide surface water are external to the farm, since groundwater is abstracted with the help of an irrigation pumpset which uses electrical energy, which is external to the farm, and since surface water is from the stored river water, which is also external to the farm.

Considering FPOA, 53 per cent of irrigated area was irrigated by irrigation wells and 47 per cent by canal irrigation. Among FPIA, 42 per cent of the irrigated area was irrigated by wells, 58 per cent by canal. The canal irrigation emanated from the Vani Vilas Sagar dam built by the Mysore Kings during 1902. Thus, considering the fact that both FPOA and FPIA enjoyed 60 per cent of their net sown area put to irrigation, FPOA are certainly no exception to using irrigation water, and thus, organic agriculture in Hiriyur taluk seem to be a proposition for only farmers who have irrigation facility.

Livestock composition

On FPOA, livestock composition and number were different compared to FPIA. The FPOA had gobar gas plant, which also provided organic manure in the form of gobar gas slurry. The FPOA had eight milch cows, four she-buffaloes, 25 sheep and four bullocks for draft purpose, obviously generating higher volume of FYM per year when compared with FPIA, as the FPIA had two milch cows, three

she-buffaloes, eleven sheep and two bullocks for draft purpose lower than that of FPOA. As the quantity of FYM on FPOA was obviously higher than that on FPIA, this enabled FPOA to use organic manures regularly (**Table 4.1**).

Irrigation

Irrigation cost in most of the studies is considered as fixed cost as (i) the actual volume of water used is usually not recorded or estimated and (ii) both the surface water and groundwater have theoretically zero marginal cost as the farmers are charged on a 'flat rate; basis of 'water rate per acre per crop' in the case of surface water from canals and (electricity cost for pumping is charged on) horse power per year in the case of groundwater from irrigation wells. In this study, an attempt is made to include the variable cost of at least groundwater irrigation, by using results of an earlier study[4]. This study considered the amortized cost of well irrigation, investment on failed wells, and the cost of cumulative well interference externality, the cost of an acre inch of water in CDZ is estimated to be Rs. 211. Considering this result (and assuming zero inflation in the cost of irrigation water), the cost of irrigation to different crops for the groundwater irrigated farms in this study was imputed at Rs. 211 per acre inch of water. Hence irrigation cost is treated as a variable cost in this study for farms which used groundwater for irrigation. Considering farms where the source of irrigation was canal, the cost of irrigation was taken as the price charged for canal water by the Revenue Department of the Government. Thus the water rate was Rs. 24 for groundnut per

[4] MG Chandrakanth, KM Sathisha, and KK Ananda, Resource Economics study of valuation of well interference externalities in Central Dry Zone of Karnataka, Ford Foundation Project Working paper, Dept of Agri Economics, UAS, Bangalore 560075, March 1998.

Fig 7: Transplanting o' paddy done by women in Hiriy

Fig 8: View of transplanted of paddy field in Hiriyu

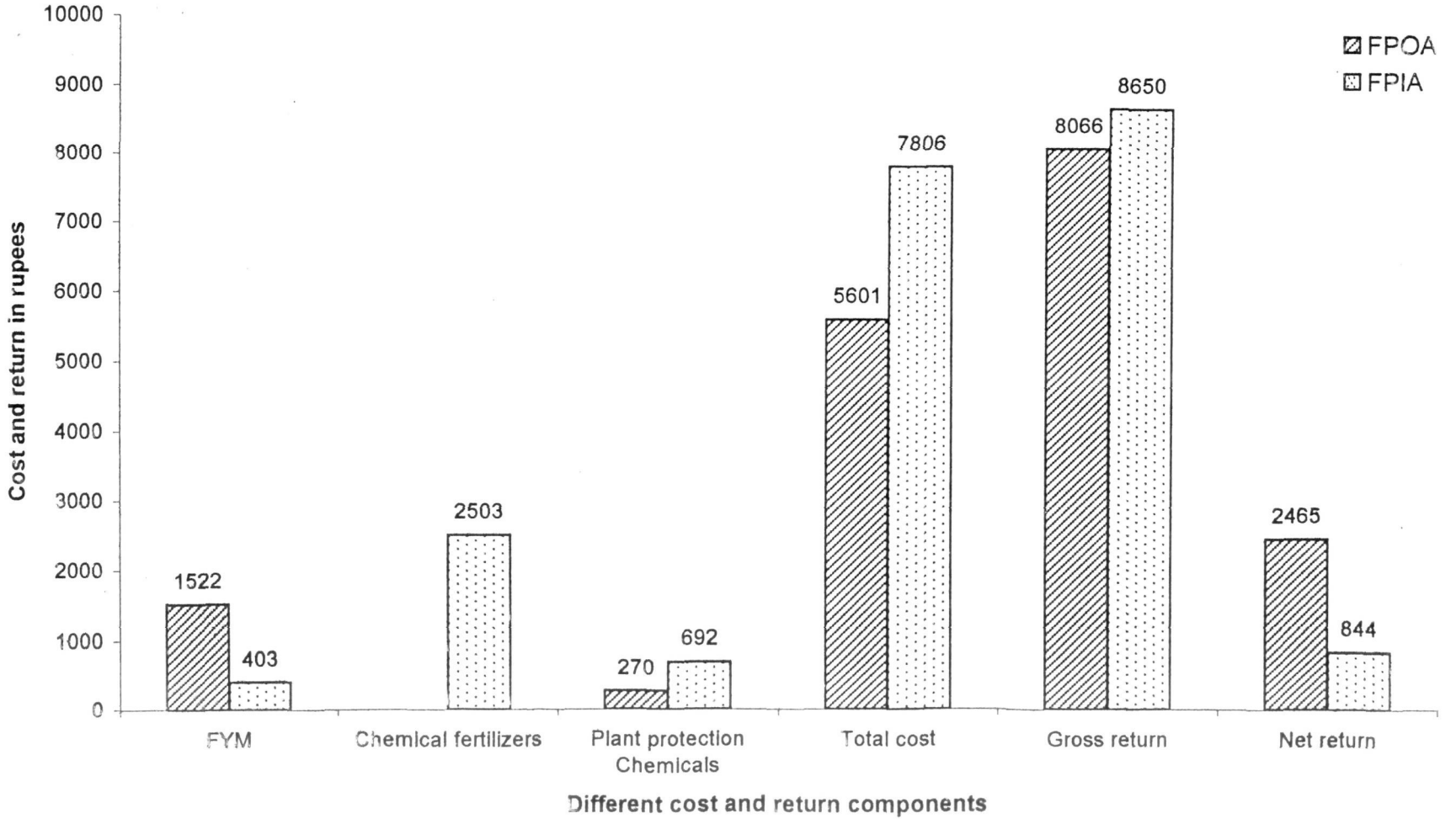
crop per acre, Rs. 35 per acre of paddy per crop. Farmers did not irrigate the sunflower crop (**Table 4.3.4, 4.3.3**).

Now that both FPOA and FPIA are using the improved varieties of sunflower, groundnut and paddy, and both have comparable access to irrigation, it is far more easier to convince the protaganists of inorganic agriculture that the transaction costs involved in the shift from inorganic to organic farming are regarding application of FYM and use of bio-pesticides. The difference in usage of these inputs and their expenditure are discussed below.

Economics of Sunflower cultivation

The FPOA applied five tonnes of FYM (worth Rs. 1522 per acre) while the FPIA applied 1.5 tonnes of FYM (worth Rs. 403 per acre). Correspondingly while the FPOA did not apply any chemical fertilizers, FPIA applied 120 kgs of nutrients (worth Rs. 2503 per acre) through chemical fertilizers. What is of economic significance is the modest yield gap of two quintals per acre between FPOA (6 quintals per acre) and FPIA (8 quintals per acre), despite application zero level of use of chemical fertilizer by the FPOA. Thus, even after the application of chemical fertilizers (or nutrients), the yield gap of a modest two quintals per acre is not substantial enough to defend the responsiveness of crop varieties to the application of chemical fertilizers. The FPIA realized a net income of Re. 0.4 per rupee of expenditure on fertilizers, while the FPOA realized a net income of Re. 1.3 per rupee of expenditure on organic manures.

Fig. 10: COST AND RETURN IN SUNFLOWER BOTH FOR FPOA AND FPIA (PER ACRE)



The FPOA spent 28 paise out of every rupee of expenditure on FYM while FPIA spent 5 paise. The FPIA had to spend Rs. 2503 per acre on chemical fertilizers to upgrade the nutrient status, which implied an expenditure of 34 paise of every Rupee on inorganic fertilizers. FPOA farms were using various sources of organic manures like green manure, concentrated organic manure and gobar gas slurry which were far cheaper and eco and econ-friendly when compared with chemical fertilizers (**Table 4.3.2**).

The expenditure on plant protection chemicals was around three times more for FPIA compared to FPOA. FPIA used chemical pesticides costing (Rs. 10768 per farm or) Rs. 692 per acre which formed 9 per cent of the cost of cultivation. FPOA spent Rs. 270 per acre on bio pesticides and they were home preparations using some purchased microbial extracts. As the extent of dependence on external inputs vis a vis local inputs is a crucial component of sustainability, farmers practicing low external input sustainable agriculture (LEISA) is a testimony for this[5]. The implications are (i) better utilization of local resources (ii) reduced dependence on external inputs. These leads to reduced costs, logistical problems of their availability and an inward looking farming approach (**Table 4.3.2**).

[5] Discussion with MG Chandrakanth, Professor, Dept of Agri Econ, UAS, Bangalore (Oct 20 1999) who mentioned about this from his experience of interacting with academicians from the USA during the annual American Agricultural Economists Association Conference in Knoxville, Tennessee, 1989.

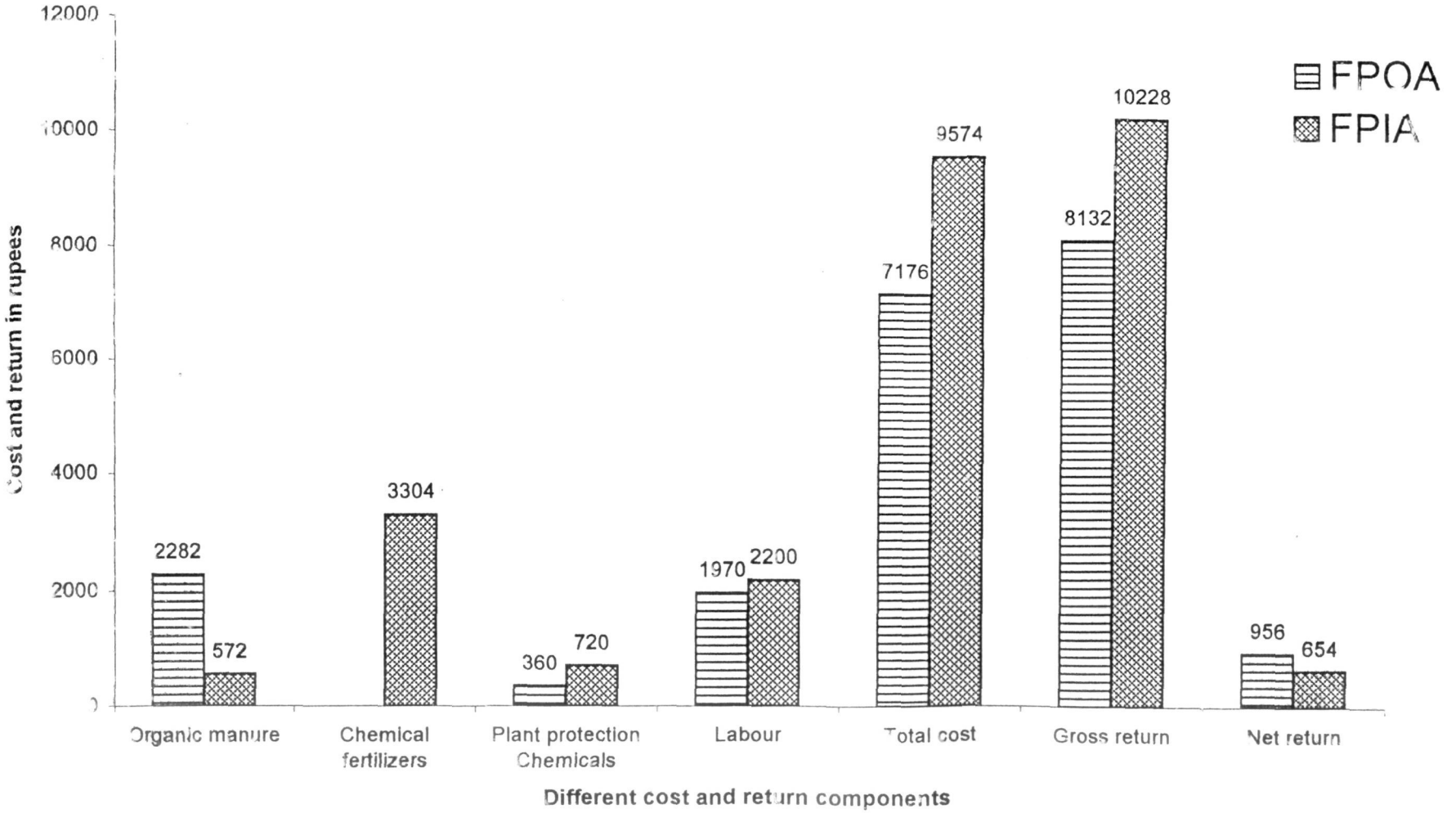
Economics of groundnut cultivation

On FPOA, the cost of FYM formed 22.3 per cent (Rs. 18106 per farm and Rs. 1605 per acre) and on FPIA the cost of FYM formed 6.2 per cent (Rs. 7382 per farm and Rs. 572 per acre) of the total cost of cultivation. The quantity of FYM used on inorganically producing farms was meager which have devastating effects on soil productivity, soil fertility status. In order to improve the fertility status on FPIA, high dose of chemical fertilizers costing Rs. 42626 per farm (Rs. 3304 per acre) were used. This formed 36 per cent of the total cost of cultivation, which was not incurred by organically producing farms. These farms were using organic manures like green manure, concentrated organic manure and gobar gas slurry which were cheaper compared with chemical fertilizers.

The expenditure on plant protection chemicals was three times higher on FPIA compared to FPOA. FPIA spent Rs. 8809 per farm and Rs. 720 per acre on chemical pesticides, which formed 7.4 per cent of the total cost of cultivation. FPOA were using biopesticides most of which were home preparations and some purchased microbial extracts and preparations of various plants and animal species worth Rs. 4072 per farm (Rs. 361 per acre).

FPOA spent Rs. 17890 per farm (Rs 1620 per acre) on human labour and Rs. 4200 per farm (Rs. 350 per acre) on bullock labour, which formed 22 per cent and 5 per cent of the total cost of cultivation respectively. FPOA spent Rs. 22350 per farm (Rs. 1850 per acre) on human labour and Rs. 2250 per farm (Rs. 150 per acre) on bullock labour. On tractor labor, they spent Rs. 2800 per farm (Rs. 200

Fig. 11. COST AND RETURN IN GROUNDNUT BOTH FOR FPOA AND FPIA (PER ACRE)



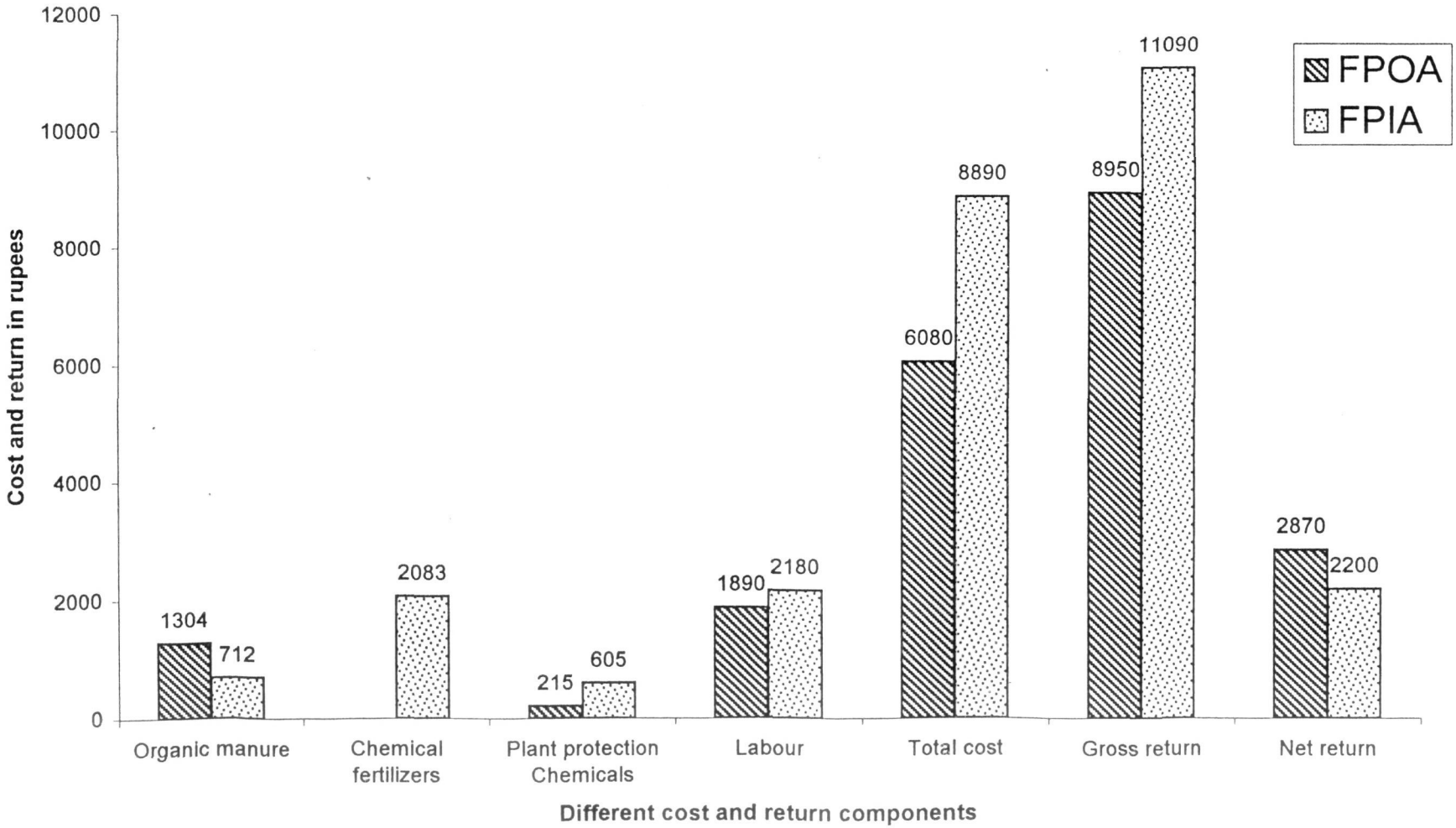
per acre) on tractor labour. The payment to labor wage formed 21 per cent of the cost of cultivation, while that for tractor labours formed around 2 per cent. FPOA were not deploying tractors for any of the cultivation purposes, as they were aware that tractor ploughing would gradually affect the soil structure (**Table 4.3.3**).

Economics of paddy cultivation

On FPOA, the cost of FYM formed 17 per cent (Rs. 4028 per farm and Rs. 1015 per acre) and on FPIA the cost of FYM formed 6.7 per cent (Rs. 2406 per farm and Rs. 712 per acre) of the total cost of cultivation. The quantity of FYM used on inorganically producing farms was meager which have devastating effects on soil productivity, soil fertility status. In order to improve the fertility status on FPIA, high dose of chemical fertilizers costing Rs. 9316 per farm (Rs. 2083 per acre) were used. This formed 26 per cent of the total cost of cultivation, which was not incurred by organically producing farms. These farms were using organic manures like green manure, concentrated organic manure and gobar gas slurry which were cheaper compared with chemical fertilizers.

The expenditure on plant protection chemicals was three times higher on FPIA compared to FPOA. FPIA spent Rs. 2535 per farm and Rs. 605 per acre on chemical pesticides, which formed 7.1 per cent of the total cost of cultivation. FPOA were using biopesticides most of which were home preparations and some purchased microbial extracts and preparations of various plants and animal species worth Rs. 852 per farm (Rs. 215 per acre).

Fig. 12: COST AND RETURN IN PADDY FOR BOTH FPOA AND FPIA (PER ACRE)



FPOA spent Rs. 4720 per farm (Rs. 1140 per acre) on human labour and Rs. 2800 per farm (Rs. 750 per acre) on bullock labour, which formed 20 per cent and 12 per cent of the total cost of cultivation respectively. FPIA spent Rs. 6890 per farm (Rs. 1650 per acre) on human labour and Rs. 1350 per farm (Rs. 300 per acre) on bullock labour. On tractor labor, they spent Rs. 1000 per farm (Rs. 230 per acre) on tractor labour. The payment to labor wage formed 20 per cent of the cost of cultivation, while that for tractor labours formed around 3 per cent by FPIA. FPOA were not deploying tractors for any of the cultivation purposes, as they were aware that tractor ploughing would gradually affect the soil structure (**Table 4.3.4**).

The input output relationship for FPOA and FPIA for all the three crops were tablulated (**Table 4.3.1**) which indicated that use of FYM by FPOA was same for all the three crops (around 5 tonnes), the FYM used by FPIA was lower which may have devastating effect on soil, though the requirement of nutrients was compensated by use of fertilizers NPK (120 kgs for sunflower, 140 kgs for groundnut and 250 kgs in paddy per acre). The seed rate of both FPOA and FPIA were comparable. FPOA used green manure which enhanced soil fertility, soil productivity, increased water holding capacity and conserved moisture as a result of which the irrigation water used was lower by FPOA compared to FPIA. The FPIA used tractor labour for various operations along with the bullock labour, FPOA used only bullock labour as they were aware that use of mechanized labour would destroy soil structure and texture. Both for FPIA and FPOA the woman

labour use was higher compared to man labour. The yield level for both FPOA and FPIA were comparable (FPIA with slightly higher yield).

Use of tractor labor

FPOA did not use tractor labor for any of their operations, while they depended on bullock labor. On the contrary FPIA used tractor labor as well as bullock labour. The FPOA were not using tractors for cultural practices as they felt using tractor would destroy the soil structure which influences soil productivity.

The total cost of cultivation of sunflower for FPOA was Rs. 125375 per farm (Rs. 7528 per acre), higher by 45 per cent per farm and 28 per cent per acre when compared with FPIA. The yield is lower in FPOA compared to FPIA by 30 percent. Hence the gross return of FPOA were lower. But the FPOA realized a net income of Re. 0.43 per rupee of cost of cultivation, while the FPIA realized a net income of Re.0.13 per rupee of cost of cultivation, which is 2.3 times higher over that of FPIA. Considering the expenditure on nutrients, the FPOA realized a net income of Re. 1.3 per rupee of expenditure on manures, while FPIA realized a net income of Re. 0.8 per rupee of expenditure on both manures and fertilizers (**Table 4.4.4**).

Labour use

The extent of labor use on FPOA and FPIA indicates that the labor use is relatively, higher on FPIA when compared with FPOA. Conceptually, the labor use should be higher on FPOA, since preparation of FYM, bio pesticides, their application and other organic farming practices are labor consuming. However, the

labor use per acre is relatively higher on FPIA when compared with FPOA. The reason for this paradox perhaps lies in the extra labor required for harvesting the additional yield on FPIA. With this backdrop, the use of woman labor is discussed below (**Table 4.5.1**).

Woman labour

Both the types of farmers have spent considerable proportion of the cost on the labour component, especially the woman labour. In fact, the FPOA generated 35 women days per acre of sunflower while the FPIA generated 42 woman days per acre. Woman labour demand constitutes more than fifty per cent of the total labor days, for all the three crops (groundnut, sunflower and paddy) on both FPOA and FPIA, (on per acre basis). The reason for a lager proportion of woman labour is because, largely women are employed during harvesting (picking) groundnut; during harvesting sunflower heads and separation of seeds from the sunflower head and during transplantation of paddy. The gender issue here is that if these crop areas are replaced or reduced by other crops which do not demand as much of woman labour, then that would affect the purchasing power of women (**Table 4.5.2, 4.5.3**).

Resource productivity

Marginal value productivity of inputs is the key for decision making regarding the economic optimal input use leading to allocative efficiency. In the cultivation of paddy, the marginal value product of the geometric mean level of 2692nd rupeee of capital spent on irrigation is 35 paise of gross returns; the marginal value product

of the geometric mean level of 4305th rupee of organic manures is Rs. 2.3. Thus, in relation to the irrigation cost of Rs. 2692, a relatively higher level of expenditure on organic manure cost of Rs. 4305, provided a marginal return of Rs. 2.31, much higher than the response to irrigation. The results are even better for labour use where marginal returns of the 6859th rupee of labour input is Rs.6.71. Thus, even though the FPOA received lower level of gross return (as reflected by negative coefficient for the intercept dummy) there is no economically substantial role played by the use of chemical fertilizers on FPIA, as reflected by the insignificant coefficient (of 0.000014) of the slope dummy for chemical fertilizers, in making significant contribution towards gross return. The role of organic manure in paddy is substantial, as the elasticity of production is 0.24. Several earlier studies conducted by the researchers in the Department of Agricultural economics, UAS, Bangalore, clearly indicated negative coefficients for organic manure and human labour. All such studies emphatically concluded that the negative coefficient is due to the over use of organic manure and labour and hence negative coefficients.

In this study for none of the crops of paddy, sunflower and groundnut the marginal value product of organic manure has shown negative returns. The contribution of 16712th rupee of organic manure to the gross return in groundnut is Rs. 5.16 and the contribution of 15511th rupee of organic manure to the gross returns in sunflower is Rs. 8.73 (**Table 4.4.1a**). Would these imply that it is economically and ecologically remunerative to increase the dose of organic manure in both these crops? This is a question which needs to be further examine giving due weightage to FPIA and FPOA, by different size of holding which obviously

forms research question for yet an another study is the prime indicator of the level of organic agriculture, a farming system worthy of emulation. In sunflower and groundnut the elasticity of production of organic manure is the largest compared to the other inputs, as they are around 0.7. This high elasticity of gross return with regard to organic manure subsumes the synergestic role of major nutrients (N, P_2O_5 and K_2O), beneficial soil microbes, the properties of organic manure in favouring the cation exchange capacity (CEC), soil structure, soil texture, water holding capacity, porosity and C:N ratio, in determining the contribution of this composite resource in the crop production, not only in one season but also with a spill-over effect for the ensuing season.

In groundnut and paddy, irrigation is a crucial factor and the marginal value product figures are positive. This is also a testimony for the contribution of irrigation. The coefficient of multiple determination for all the three crops was above 0.9. In groundnut the contribution of 4729th rupee spent on seed towards gross return is Rs. 7.72 (**Table 4.4.2a**).

Externalities in FPOA

The concept of externality used in this study, refers to the benefits accrued to the farmers in question as well as the spill over effects on neighboring farms. Due to the use of organic manures, the soil gets enriched and the neighbouring farmers derive the spill-over effects of rich soil flora, fauna, diversity of beneficial plants on the farm which can harbour beneficial insects like predators which will promote biological control and then avoid the lateral, surface and sub-surface movement of chemical fertilizers, pesticides, as they are not used by FPOA. Thus, the FPOA and FPIA are both benefited by the farming practices of FPOA due to

the above spill over effects or positive externalities. As these are dynamic and not pronounced in the short run, it is difficult to capture and value these spills over effects. However a modest attempt is made to capture just a layer of externality as equal to the net gains obtained between FPOA and FPIA (using partial budgeting technique) (**Tables 4.6.1, 4.6.2 & 4.6.3**). It is estimated that a sum of Rs. 1297 in sunflower, Rs. 87 in groundnut and Rs. 31 in paddy per acre is the additional benefits for organic farms (which is attained through partial budgeting). Some of the benefits of organic agriculture are as follows:

1. Reduced dependents on purchased inputs.
2. Rotation with deep-rooted crops optimizes nutrient uptake.
3. Improvement in soil fertility and soil health.
4. Increase in water holding capacity.
5. Produce will be free from chemical residual effect. In India inadvertently, the dietary intake of pesticide residue is 362 mg/day/vegetarian and 356 mg/day/non-vegetarian. A major portion of the residues in the diet is due to DDT and BHC isomer residues.
6. Use of chisel ploughing instead of mouldboard ploughing minimizes the downward movement of nutrients in the soil profile.
7. Improvement in disease resistance of crop varieties in organic agriculture.
8. Better keeping quality of the produce and decreased post harvest losses.
9. Conservation of biodiversity results in an environment with low levels of chemical pollution.
10. In International market organic farm produce fetches 20 to 50 per cent, higher price over conventional produce.

SUMMARY

CHAPTER VI

SUMMARY

The term Organic farming can be used to imply farming practices undertaken by treating the entire farm as the one made of related parts arranged, as a system, to enable interactions and synergies between and within the related parts of the system, for an economically sustainable agriculture. This definition subsumes complex ecological and economic relationships contributing synergistically for the overall development of the farm and farm family, without conflicting with nature. In addition, organic farming assures fuller utilization of byproducts on the farm, greater emphasis on local inputs rather than on external inputs, self-reliance rather than dependency, and making the best use of interlinkages on the farm. The interlinkages mean, output and byproduct from one enterprise, serving as input in other enterprise(s), fuller utilization of family labor providing gainful employment for a long period.

Nevertheless, such a fundamental implication of organic farming cannot be practically seen on a large scale in Indian agriculture. There will be deviations or adaptations due to heavy influence of modern agriculture. A prime dilution of the classic organic farming concept *inter alia* is the use of high yielding or improved variety responsive to chemical fertilizers, and use of groundwater irrigation by using electrical/diesel pumps.

In these days of increased utilization of agro chemicals and the resulting spillovers, it is not an uncommon belief that organic farming can never be a

panacea for feeding the masses. It is a common belief that organic agriculture is suitable for irrigated agriculture and for commercial crops, for farmers who are practicing on a large scale. What is paradoxical is that in the very country where organic farming was a rule rather than an exception, inorganic agriculture has taken its place to the extent that the very same farmers who used to practice organic agriculture about two and half decades ago, are not prepared to accept the benefits of organic farming. Such debates are continuing adding to more confusions. There have not been attempts to analyze the economics of viability of organic farming, since farmers seem to be reinventing their wheel! This study is a modest attempt to reflect on the economics of viability of organic agriculture especially for field crops in the Central Dry Zone of Karnataka, with the following specific objectives:

1. Estimation of costs and returns of crops cultivated on organically and inorganically producing farms and their comparative economics.
2. Analysis of resource productivity and allocative efficiency in the production of organically grown crops.
3. Study of labour use pattern in cultivation on organic and inorganic farms.
4. Estimation of externalities due to organic and inorganic cultivation.

The primary data for this study have to invariably be from farmers practicing organic agriculture (FPOA) and need to be contrasted with data from farmers practicing inorganic agriculture (FPIA). The preliminary information from reconnaissance survey indicated that the FPOA are not in continuous plots, but are spread over at least 18 villages. This has two implications; (1) that if

organic farming practices were to be popular, the researcher should have obtained the desired sample of around 30 farmers in just a village and (2) these farmers would just be located in proximity. Both these factors turned out to be the odds for the researcher who had to survey 18 villages in Hiriyur taluk in order to trace 32 farmers practicing organic agriculture for field crops of sunflower, groundnut and paddy.

The sample for the study encompassed only large farmers each holding around 45 acres land per farm, where 60 per cent of their net sown area was irrigated by canals and wells on both organic and inorganic farms.

Considering the livestock on the farm, the FPOA had eight milch cows, four milch she-buffaloes, two bullocks for draft purpose and 25 sheep. Contrastingly the FPIA had lower profile of livestock with two milch cows, three milch she-buffaloes, one bullock for draft purpose and 9 sheep.

Crop pattern:

The FPOA devoted 21 per cent of the net sown area for plantation crops (coconut 11.1 per cent, arecanut 9.5 per cent). Considering the irrigated land, FPOA devoted 9.8 per cent of irrigated land on food crop (paddy), 28.4 per cent on oil seed crop (groundnut) and the remaining on commercial crops (like cotton). FPIA on the other hand devoted 9.4 per cent to paddy, 29 per cent for groundnut and 19 per cent for the commercial crops (like fig, cotton, pomogranate, coconut,

arecanut). The extent of commercialization on FPOA and FPIA was strong also on the rainfed land as 32 per cent of the area was devoted to oil seed crop like sunflower.

Costs and returns from sunflower, groundnut and paddy crops

Considering the cost of cultivation of sunflower for FPOA, the expenditure on organic manures formed 35 per cent of the cost of cultivation. For FPIA, the expenditure on nutrients (manures and fertilizers) formed a similar 33 per cent of the cost. The expenditure on plant protection chemicals by FPIA was 70 per cent higher than FPOA. On the one hand, while the variable costs of FPIA were 53 per cent higher than the variable costs of FPOA, on the other hand, the gross returns of FPOA were 69 per cent lower than that of FPIA, as the yield levels of FPOA were lower. The net returns of FPOA were however higher by 45 per cent over FPIA.

Considering the cost of cultivation of groundnut on FPOA and FPIA, the organic manures form 34 per cent of the cost of cultivation. The cost of production per acre was Rs. 7176 yielding a net return of Rs. 956 per acre on FPOA. The FPOA spent five per cent of the cost on biopesticides while the FPIA spent seven per cent of the cost on plant protection chemicals. FPOA realized a net return of Rs. 1969 per acre over variable costs, and reaped a net cost benefit ratio of 0.3 over variable cost. Considering the FPIA, they incurred 36 per cent on fertilizers, which is comparable with that of FPOA. FPOA spent RS 2282 per acre while the FPIA spent 3876, which is 70 per cent higher over FPOA. Similarly, the FPOA spent just 50 per cent (Rs351) of the expenditure on plant protection

chemicals spent by FPIA (Rs. 720). The labour use on both the types of farmers is comparable. While the gross returns are 25 per cent lower on FPOA compared to FPIA, the net returns per acre per acre over variable costs are comparable, because there is a saving of 26 per cent in cost of cultivation in variable costs on FPOA.

Considering the cost of cultivation of paddy on FPOA, the expenditure on organic manures formed 22 per cent of the cost of cultivation. On FPIA the expenditure on nutrients (manures and fertilizers) form 33 per cent of the cost of cultivation. The average productivity considering the nutrients on FPOA was Rs. seven while that on FPIA was Rs. four. On FPIA the cost of plant protection chemicals was Rs. 605 per acre which is 66 per cent higher than the cost of biopesticides on FPOA (Rs. 215 forming four per cent of the cost). On FPOA, 63 per cent of the total labour are woman labour and their wage bill formed 52 per cent of the total wage bill. On FPIA, 68 per cent of the total labour is woman labour forming 57 per cent of the wage bill.

Woman labor requirement is usually high for cultivation of paddy, as the various operations in which woman labour is employed are tranplanting, weeding and harvesting. On FPOA 71 per cent of the total labour employed were woman forming 61 per cent of the wage bill which is on par with FPIA.

Resource productivity and allocative efficiency

Production function of a mix of transcendental function with the introduction of slope and intercept dummy variables was estimated for each of the three crops to

study the relationship between the gross returns and input costs. An intercept dummy variable for differentiating between organically and inorganically producing farmers was used. Another slope dummy variable to differentiate between farmers using fertilizers and organic manures was used.

The production function analysis indicated that the marginal productivity of 15,511th Rupee of organic manurial input added Rs. 8.73 to the gross income of sunflower, keeping all other input use at their respective geometric mean level.

In groundnut, the contribution of 16712th rupee spent on organic manure is Rs. 5.16 to the gross returns and is statistically significant. The contribution of the seed to gross returns is high at Rs. 7.7 (for the 4729th rupee spent). The coefficient of multiple determination is 0.97. The elasticity of production of organic manure was high at 0.69.

For paddy, the elasticity of production was 0.55 for labour and 0.24 for organic manure and both were statistically significant. Though the slope dummy was statistically significant, the coefficient of elasticity was meager at 0.000014.Intercept dummy also was statistically significant. The marginal return for 4305th rupee spent on organic manure was Rs. 2.31, the marginal return for 8075th rupee spent on labour was 6.71.

Partial budgeting is used to analyze the externalities of organic farming. The partial budgeting is computed by considering the corresponding differences in increase in costs, decrease in returns, savings or decrease in costs and increase in returns between organically and inorganically producing farmers for three

different crops selected for the study. The partial budgeting indicated that the returns to cost made by the organically producing farmers is beneficial since the difference between the contribution of organic and inorganic agriculture per farm Rs.1297 for sunflower, Rs. 87 for groundnut and Rs. 31 for paddy.

Implications

1. Considering the field crops like sunflower, groundnut and paddy, organic farming is relatively more profitable (by Rs. 1297, Rs. 87 and Rs. 31 respectively) than inorganic farming for large farmers with irrigation facility. Could this erase the belief that organic farming is feasible only for commercial crops and plantation crops where the rainfall is substantial and where there is relatively no dearth of organic manure is a much broader issue for further research.
2. Even though organic farming should strictly be based on the use of "local" varieties of seeds, which are responsive to local inputs like FYM, green manure, gobar gas slurry, bio pesticides and/or other organic farming practices, it was found that both organic and inorganic farmers practicing agriculture, used "improved" varieties (high yielding varieties and/or hybrid varieties) of crops, since strictly 'local' varieties are not available with the farmers due to several types of mixtures and dilutions due to the plant breeders' efforts towards seed development.
3. Though total labor on FPOA, should be higher than on FPIA (on theoretical basis), as organic agricultural practices do demand higher labor when compared with inorganic farming, the study indicated the opposite. That is,

FPOA used lower labor per rupee of output, when compared with FPIA (Rs. 0.18 per rupee of output). This is due to the higher physical output on FPIA when compared with FPOA. Thus, if there is spread of FPOA, the employability of agriculture labor can be at stake. This however needs further research.

4. There was no price difference for the produce between the FPOA and FPIA in all the three crops sunflower, groundnut and paddy. This shows that it has not been possible for the consumers/farmers to appreciate the positive externalities of Organic Agriculture in Hiriyur market. Nevertheless, in Bangalore Metropolis, there is a price premium for organically grown vegetables. Thus, unless the market recognizes and internalizes the externality costs, people will have no preference or otherwise to consume organically grown produce.

Focus of future research

Since the FPOA and FPIA are both using improved varieties of crops, with good irrigation facility and with large farm size and have proved their economic viability, it is desirable to conduct a similar study to verify whether small and marginal farmers can also follow economically viable organic agriculture.

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CHAPTER VII

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