CMA Publication No - 239

Organic Input Production and Marketing in India – Efficiency, Issues and Policies

D.Kumara Charyulu
Subho Biswas

September 2010

Foreword

The Centre for Management in Agriculture (CMA) at the Indian Institute of Management, Ahmedabad (IIMA) is engaged in applied and problem solving research in agribusiness management as well as achieving broader goals of agricultural and rural development since its inception. As a result, over the years, CMA has developed an expertise in a large spectrum of issues in agribusiness sector including agri-input marketing, agro-processing, agri-food marketing, livestock, fisheries, forestry, rural and market infrastructure, agri-biotech sector, grass-root innovations, linking smallholder producers to emerging markets, international agricultural trade including the WTO issues, global competitiveness, commodity markets, food safety and quality issues, etc. CMA undertakes research projects of this kind not only on its own, but also at the request of its clientele group, which includes the Ministry of Agriculture, Government of India, other state and central government Ministries, international bodies, private corporations, cooperatives and NGOs.

The present study is undertaken at the request of the Ministry of Agriculture to know the present status of the organic input units sanctioned under National Project on Organic Farming (NPOF) scheme since October, 2004. The project has different components like training programs, demonstrations, capacity building through service providers, setting up of organic input production units etc. Setting up of organic input units is an important component with a sizeable allocation under the project. For setting up of organic input production units, financial assistance is being provided as credit-linked and back-ended subsidy through NABARD and NCDC. Three types of organic input units i.e., vermi-hatchery units, bio-fertilizer units and fruit and vegetable waste compost units are being encouraged under the project. Broadly, the present study has covered five major issues. First, the study has presented an overview of organic farming in the World and in India. The SWOT analysis of organic farming to articulate, refine policy prospective and scheme has been reviewed. Second, the study has lucidly summarized the status of input production in India. Third, the study has also analyzed the capacity utilization and efficiency of organic input units under NPOF scheme and their determinants. Four, the study highlighted problems in procurement and usage of organic inputs by end-users in the study area. Five, study has presented a fairly comprehensive picture of economics and efficiency of organic farming vis-à-vis conventional farming systems in India. The study provided valuable insights for undertaking appropriate measures for expansion of organic farming in the country.

I hope that findings of this study would be helpful for Ministry of Agriculture for possible modifications and effective implementation of the scheme as well as to organic producers and other stakeholders in organic produce supply chains in the country.

Vijay Paul Sharma
Chairman
Centre for Management in Agriculture

Ahmedabad
Date:

Preface

GREEN revolution technologies involving greater use of synthetic agrochemicals such as fertilizers and pesticides with adoption of nutrient-responsive, high-yielding varieties of crops have boosted the production output per hectare in most cases. However, this increase in production has slowed down and in some cases there are indications of decline in productivity and production. Moreover, the success of industrial agriculture and the green revolution in recent decades has often masked significant externalities, affecting natural resources and human health as well as agriculture itself. Environmental and health problems associated with agriculture have been increasingly well documented, but it is only recently that the scale of the costs has attracted the attention of planners and scientists. Increasing consciousness about conservation of environment as well as of health hazards caused by agrochemicals has brought a major shift in consumer preference towards food quality, particularly in the developed countries. Global consumers are increasingly looking forward to organic food that is considered safe and hazard-free. Global demand for organic products remains robust, with sales increasing by over five billion US Dollars a year. According to the Organic Monitor, international sales estimates have reached 38.6 billion US Dollars in 2006; double that of 2000, when sales were at 18 billion US Dollars.

India is bestowed with lot of potential to produce all varieties of organic products due to its agro-climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. The important events in the history of the modern nascent organic farming in India were unveiling of the “National Programme for Organic Production” (NPOP) in 2000 and “National Project on Organic Farming” (NPOF) in 2004. The NPOF scheme has components like capacity building through service providers; financial support to different production units engaged in production of bio-fertilizers, fruit and vegetable waste compost and vermi-hatchery units and human resource development through training on certification and inspection, production technology etc. The establishment of production units under this scheme is being provided as credit-linked and back-ended subsidy by NABARD and NCDC. Around 455 vermi-hatchery units, 31 bio-fertilizer units and 10 fruit and vegetable waste units were sanctioned across different states by NABARD till May, 2009. But, NCDC has so far sanctioned only two bio-fertilizer units in Maharashtra state. At this juncture, it is very interesting to know what the present status of these units, what the production and capacity utilization of each unit and suggestions for enhancing capacity utilization etc. The present study revolves around the following issues:

- What is the capacity utilization and efficiency of organic input units sanctioned under NPOF scheme?
- What are the constraints in establishment of units and identification of problems in marketing of organic inputs?

- What are the constraints in procuring and using organic inputs by the farmers?
- What are the suggestions for effective implementation of project?

Chapter 2 of the report reviews the status of organic farming in the World and India, SWOT analysis of organic farming and briefly summarizes the government policies in India. Chapter 3 gives the present status of organic input production in India. In Chapter 4, brief review, analytical framework and specification of DEA model are presented. Empirical results including productivity and efficiency of sample units are examined. Costs and returns of vermi-compost production across different states and regions are compared. Problems in establishment of units and constraints in production are discussed. Finally, suggestions for promoting of organic input production units are discussed.

In Chapter 5, presents the eight cases on three types of organic input units. Chapter 6 highlights the different marketing channels exists for marketing of organic inputs in the study area. The problems in procurement and usage of organic inputs are discussed. Chapter 7 analyzes the economics and efficiency of organic farming vis-à-vis conventional farming in different states of India.

Finally, the summary and conclusions of the study and policy implications are summarized in Chapter 8. The average capacity utilization of vermi-hatchery units was only 50.8 per cent which indicates nearly half of its full potential. The estimated mean technical, allocative and economic efficiencies of sample units were low. Strengthening of both input and output marketing channels is the need of the hour for rapid expansion of organic farming in the country.

D.Kumara Charyulu
Subho Biswas

Contents

Acknowledgements

Several individuals and organizations have helped us immensely during completion of this study. Acknowledging each and every individual would be impossible but we would amiss if we don't mention few individuals and organizations without whose support and help it would have been difficult for us to complete this study. First and foremost we would like to thank Ministry of Agriculture, Government of India, for their generous financial support for this study.

Our special thanks to Centre for Management of Agriculture (CMA), Indian Institute of Management (IIM), Ahmedabad for giving us this opportunity. We are highly thankful to Prof. Vijay Paul Sharma, Chairman of CMA for his constant encouragement and support in conduct of this study. We express our profound sense of gratitude to Prof. Samar K Datta for his valuable guidance and constructive criticism during the study period. We highly appreciate the suggestions and guidance given by Prof Sukhpal Singh in the study design and conduct of field surveys. We humbly place on records our respect to Prof Vasant P Gandhi for his valuable suggestions in bringing out this report.

Finally but very importantly, our list of thanks and acknowledgements for their help in producing this manuscript is a long one. We are very grateful to The National Bank for Agriculture and Rural Development (NABARD), Mumbai and National Cooperative Development Council (NCDC), New Delhi who have helped us in providing the necessary information and data about NPOF scheme. We are thankful to the National Centre for Organic Farming (NCOF), Ghaziabad for providing the technical details, guidelines and manuals of schemes and various publications. We highly appreciate the support provided by NABARD Regional offices, DDMs of all the study districts, NCDC Regional office, Pune and Managers of various financial banks and Cooperatives during our field visits in the four states. Our heartfelt thanks to Hasmukh Patel, GM Agrocel Industrial Ltd, Gujarat; Mahajan Ji, Warana Bazaar in Maharashtra; Umendra Dutt, Kheti Virasat Misson, Punjab and Sri Krishna Ji, Lok Bharathi, Ahmednagar, U.P for their painstaking support in introducing us to various organic farmers. We are thankful to IEG, New Delhi for their comments and suggestions on the earlier version of this report. The authors are also extremely grateful to Dr.K.P.C Rao, Principal Scientist (ICRISAT), Prof S.R Asokan, IRMA and Prof P. Venugopal, XLRI for kindly going through an earlier draft of this manuscript and providing valuable inputs. Our sincere thanks are also to A.K Vasisht, Asst. Director General (ESM/PIM) for providing his expert comments on this report. We sincerely acknowledge the help rendered by the staff members of CMA office, IIM, A for their utmost help and cooperation during the preparation of this report. Last but not the least, we owe to all the promoters of the units and farmers for their patience answering, hospitality and sparing their valuable time with us.

D.Kumara Charyulu
Subho Biswas

List of Abbreviations

AE: Allocative Efficiency
AICRPPR: All India Coordinated Research Project on Pesticide Residues
AME: Agriculture, Man and Ecology
APEDA: Agricultural and Processed Food Products Export Development Authority
AQIS: Australian Quarantine and Inspection Service
ARISE: Agricultural Renewal in India for Sustainable Environment
BNF: Biological Nitrogen Fixation
CE: Cost Efficiency
CF: Conventional Farming
COP: Cost of Production
CRS: Constant Returns to Scale
DEA: Data Envelopment Analysis
DMU: Decision Making Unit
DRS: Decreasing Returns to Scale
EE: Economic Efficiency
EIA: Export Inspection Agencies
EIC: Export Inspection Council of India
ETL: Economic Threshold Level
FAO: Food and Agriculture Organization
FCO: Fertilizer Control Order
FiBL: Research Institute of Organic Agriculture, Switzerland
FST: Farming Systems Trial
FTDR: Foreign Trade Development and Regulation
FYM: Farm Yard Manure
GCA: Gross Cropped Area
GDP: Gross Domestic Production
GGC: Grower Group Certification
GHG: Green House Gases
GM: Genetically Modified
Ha: Hectare
HYV: High Yielding Varieties
ICCOA: International Competence Centre for Organic Agriculture
ICRISAT: International Crops Research Institute for the Semi-Arid Tropics
IFFCO: Indian Farmers Fertilizer Cooperative Limited
IFOAM: The International Federation of Organic Agriculture Movements
IIRD: Institute for Integrated Rural Development
ILEIA: Centre for learning on sustainable agriculture
INF: Industrial Nitrogen Fixation
INM: Integrated Nutrient Management
IOAS: International Organic Accreditation Services
IPCC: Intergovernmental Panel on Climate Change
IPM: Integrated Pest Management
IPNM: Integrated Plant Nutrient Management
IRS: Increasing Returns to Scale
JMC: Joint Monitoring Committee
Kg: Kilo-gram
KVK: Krishi Vigyan Kendra

LCA: Life-Cycle Assessment
MRL: Maximum Residual Level
MT: Metric Ton
NABARD: The National Bank for Agriculture and Rural Development
NCDC: National Cooperative Development Corporation
NCOF: National Center of Organic Farming
NCRB: National Crime Records Bureau
NGO: Non-Governmental Organizations
NHM: National Horticultural Mission
NOP: National Organic Program
NPOF: National Project on Organic Farming
NPOP: National Programme for Organic Production
NSSO: National Sampling Survey Organization
OCIA: Organic Crop Improvement Association
OF: Organic Farming
PGS: Participatory Guarantee System
Qtl: Quintal
RCOF: Regional Centre of Organic Farming
RRB: Regional Rural Banks
SAT: Semi-Arid Tropics
SCARDB: State Co-operative Agricultural and Rural Development Banks
SCB: State Cooperative Banks
SFA: Stochastic Frontier Analysis
SWOT: Strengths, Weaknesses, Opportunities and Threats
TE: Technical Efficiency
TFO: Total Financial Outlay
TGR: Technology Gap Ratio
TPA: Tons Per Annum
TPD: Tons Per Day
UKROFS: United Kingdom Register of Organic Food Standards
USDA: United States Department of Agriculture
USP: Unique Selling Proposition
VAT: Value Added Tax
VRS: Variable Returns to Scale
WCED: World Commission on Environment and Development
WHC: Water Holding Capacity
WHO: World Health Organization

List of tables

List of graphs/figures

Chapter I

Introduction

1.1 Sustainable development

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations. It has also been defined as balancing or fulfillment of human needs with the protection of the natural environment so that these needs can be met in the indefinite future. According to the "Brundtland Commission" which coined the term what has become the most often-quoted definition of sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED Report, 1987)[1].

Sustainable development - A new paradigm

The field of sustainable development can be conceptually divided into four general dimensions: social, economic, environmental and institutional. The first three dimensions address key principles of sustainability, while the final dimension addresses key institutional policy and capacity issues. The three essential aspects of sustainable development are:

Social - A socially sustainable system must achieve fairness in distribution and opportunity, adequate provision of social services, including health and education, gender equity, and political accountability and participation.

Economic - An economically sustainable system must be able to produce goods and service on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances that damage agricultural or industrial production.

---

[1] See also Vanloon G.W *et al.,* (2005) for detailed discussion

Environmental - An environmentally sustainable system must maintain a stable resource base, avoiding overexploitation of renewable resources systems or environmental sink functions and depleting nonrenewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.

Despite of many complications, the three principles outlined above do have resonance at a common-sense level (Fig1.1). Surely if we could move closer to achieving this tripartite goal, the world would be a better place; equally surely; we frequently fall short in three respects. Thus there is ample justification for the elucidation of a theory of sustainable development, which must have an interior disciplinary nature[2].

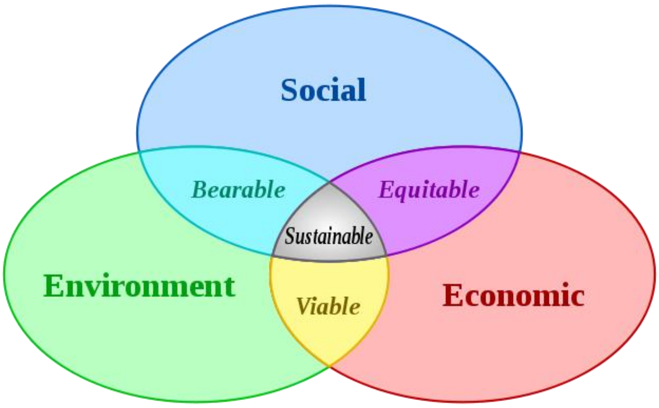


Fig 1.1 Scheme of sustainable development (Source: Barbier E., 1987)

Sustainable Agriculture

Sustainable agriculture refers to the ability of a farm to produce fertile soil for crops and produce along with livestock and fish from managed ponds, without causing severe or irreversible damage to ecosystem health. The two key issues in sustainable agriculture are: biophysical, the long-term effects of various practices on soil properties and processes essential for crop productivity and socio-economic, the long-term ability of farmers to obtain inputs and manage resources such as labor.

[2] For details see "A Survey of Sustainable Development – Social and Economic Dimensions (2001)"

Sustainable agriculture integrates three main goals i.e., environmental health, economic profitability, and social and economic equity. Sustainable agriculture is necessary to attain the goal of sustainable development. According to the Food and Agriculture Organization (FAO, 2007), sustainable agriculture “is the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources”. All definitions of sustainable agriculture lay greater emphasis on maintaining an agricultural growth rate, which can meet the demand for food without draining the basic resources.

1.2 Need for sustainable/alternative farming system

The performance of the agricultural sector influences the growth of the Indian economy. Agriculture (including allied activities) accounted for 15.7 per cent of the Gross Domestic Product (GDP-at constant prices) in 2008-09 as compared to 21.7 per cent in 2003-04. Notwithstanding the fact that the share of this sector in GDP has been declining over the years, but its role remains critical as it accounts for about 52 per cent of the employment in the country. Agricultural sector also contributed 10.2 per cent of national exports in 2008-09 (Economic Survey, 2009-10). Agriculture provides food for more than one billion people and yields raw materials for agro-based industries. Modernization of Indian agriculture has began during the mid-sixties which resulted in the ‘Green Revolution’ making the country a food grain surplus nation from a deficit one depending on food imports. But, modern agriculture has yielded several problems besides creating a very unsustainable system for mankind (Worthington, 1980). Cultivation of crops became more dependent on inputs purchased from the market, and farmers began to sell a greater share of the crop in the market. The rising costs of cultivation and uncertain output prices made the modern agriculture system non-viable.

Problems in conventional/modern farming

a. Impact of Green Revolution

The misplaced glory of Green Revolution was on the basis of the use of High Yielding Varieties (HYV), heavy doses of chemical fertilizers, pesticides, and heavy farm mechanization that led to unprecedented pressure on our natural resource base. Green Revolution has encouraged an increase in the production of mainly two crops, wheat and rice, but the cost paid was in terms of destruction of other crops (especially coarse cereals and pulses) and over exploitation of precious water resources and fertile soils. The high dosage application of fertilizers (see fig 1.2) deteriorated the physical, chemical and biological properties of soil on one side, on the other, increased soil salinity and pollution of ground water resources. The use of pesticides has been posing serious environmental and health problems. Due to the changed mode of traditional agriculture, disappearance of cattle from the farms, reducing biodiversity, reducing biological productivity and nutrient recycling creating a crisis of non-sustainability, both economical and ecological. Monoculture of crops by exploiting the natural resources and ignoring the externalizing ecological and environmental costs with a false image of crop yields. After the withdrawal of initial subsidies, the external/high cost input combination of crop production can not be sustainable in the long run. This is clearly evident in pushing the farmers in to a debt trap or high dependency on credit (NSSO 59th Round, 2003).

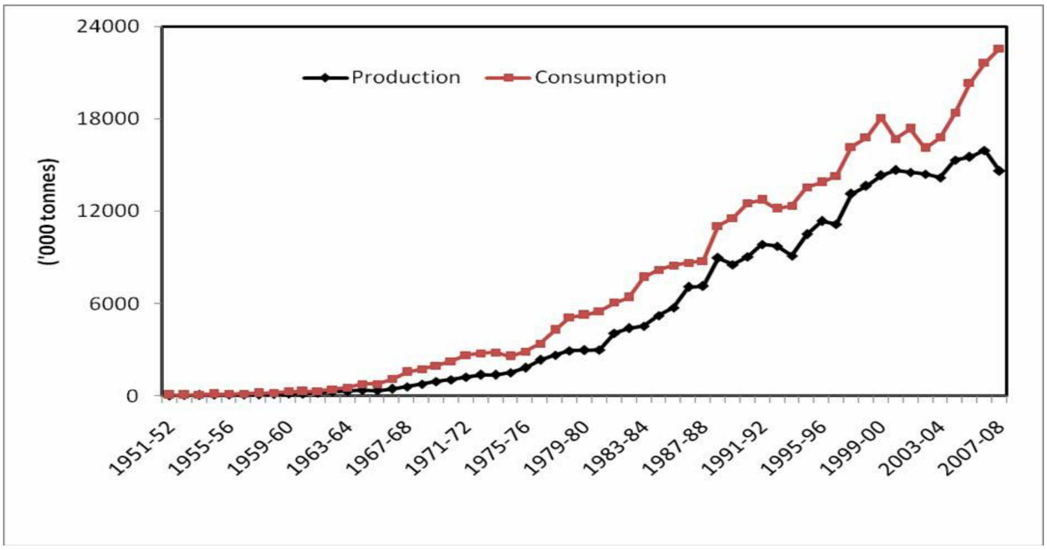


Fig 1.2 Fertilizer production and consumption in India, 1951-52 to 2007-08
(Source: Sharma and Hrima, 2009)

b. Impact on soil characteristics

The indiscriminate use of fertilizers increases the phosphate, nitrate and heavy metals content in soil. The excessive inorganic elements accumulate in the soil lead to immobility of many essential nutrients, finally forms a kanker pan in the terrestrial ecosystem. Example, application of DAP immobilize the phosphate and is strongly adsorbed in the soil surface. Another problem of phosphate is absorption of heavy metals in the soil. Heavy doses of application of fertilizers caused irreversible damage to the soil structure over the years. When the soil productivity graph declined, the poor farmers resorted to increase the dosage of chemical fertilizers to sustain farm production. The increased chemical inputs resulted in soil toxicity, disturbed the soil micro-environment and there-by impeded organic matter recycling in the soil.

c. Impact on climate

In agro-ecosystems, mineral nitrogen in soils is the driver of crop productivity in many cases. Crop productivity has increased substantially through utilization of heavy inputs of soluble fertilizers – mainly nitrogen and synthetic pesticides. However, only 17 percent of the 100 Mt N produced in 2005 was taken up by crops. The remainder was somehow lost to the environment. Between 1960 and 2000, the efficiency of nitrogen use for cereal production decreased from 80 to 30 percent (Erisman, *et al.*, 2008). High levels of reactive nitrogen (NH4, NO3) in soils may contribute to the emission of nitrous oxides and are main drivers of agricultural emissions (fig 1.3).

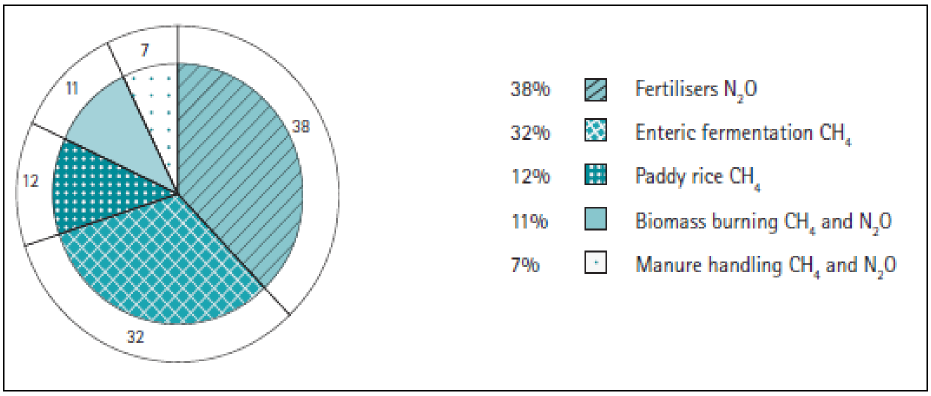


Fig 1.3 GHG emissions of the Agricultural sector (Source: Smith *et al,* 2007)

The efficiency of fertilizer use decreases with increasing fertilization because a great part of the fertilizer is not taken up by the plant but instead emitted into the water bodies and the atmosphere. The emission of GHG in CO_2 equivalents from the production and application of nitrogen fertilizers from fossil fuel amounted to 750 to 1080 million tonnes (1 to 2 percent of total global GHG emissions) in 2007. In 1960, 47 years earlier, it was less than 100 million tonnes. In summary, each year, agriculture emits 10 to 12 percent of the total estimated GHG emissions, some 5.1 to

6.1 Gt CO_2 equivalents per year. Smith, *et al.* (2007) and Bellarby, *et al.* (2008) have proposed mitigation options for GHG emissions, finding that both farmers and policy-makers will face challenges from the GHG-related changes needed in agriculture.

d. Reduction in genetic-diversity and threat of GM crops

Prior to the Green Revolution, diversity in crops was a key factor in agricultural systems in India. It provided stability and resilience to the systems as well as economic security to the farmers. However, after the introduction of modern technology, more emphasize upon mono-cropping, high mechanized farming focused on single function of single species. This resulted in the erosion of genetic diversity base of agro-ecosystems. The destruction of agro-biodiversity has resulted in depriving the marginal farmers getting multiple products from the farms. Many research studies have proved that reduction in genetic-diversity lead to more susceptibility to pests and diseases.

Genetically Modified (GM) foods are prepared by altering the genetic make-up of plants by inserting genes from one species artificially into another one. The essential reason they were introduced because it was assumed that they would ensure an adequate food supply for the world population that is growing at an alarming rate. These foods increase resistance to pests and herbicides and therefore help in eliminating the use of chemical pesticides and various time consuming and expensive processes to destroy weeds. More importantly, in countries like India, it is believed by experts that these foods would also help in removing malnutrition as normal foods can be genetically engineered to contain additional vitamins and minerals (Science, 2009).

Though it is argued that these foods are a sure shot way to reduce hunger in developing countries like India, but, many people believe that if hunger could be solved by technology alone green revolution would have done it long ago. Genetically modified foods would just succeed in strengthening corporate control over agriculture research and contributes significantly to developed countries and not to the resource-poor farmers in developing countries (Pingali and Traxler, 2002; Rao and Mahendra Dev, 2009). Qaim (2005) also highlighted the pattern of adoption these technologies in developing countries and summarized their possible influences in three folds: a. Intellectual Property Rights (IPRs) b. associated with new environmental and health risks and c. modern biotechnology permits a separation between the act of developing a specific crop trait and breeding of locally adapted germplasm.

e. Contamination of food and decline in nutritive values

The incessant application of chemicals not only polluting the grains but also the food we consume (Rup Lal *et al.*, 1989; ICMR Bulletin, 2001). The process of bio-magnification[3] and bio-concentration[4] has lead to the accumulation of these chemicals both in the tissues of the crops and also of the humans. The wide spread application of chemicals lead to genetic mutation of pests and develop resistance to these chemicals. According to Pimentel, 1995 only 0.1% of pesticide actually reaches the target pests and the rest go to non-target sectors. The details of consumption of pesticide (technical grade) in India from 1991 to 2007 are presented in fig 1.4.

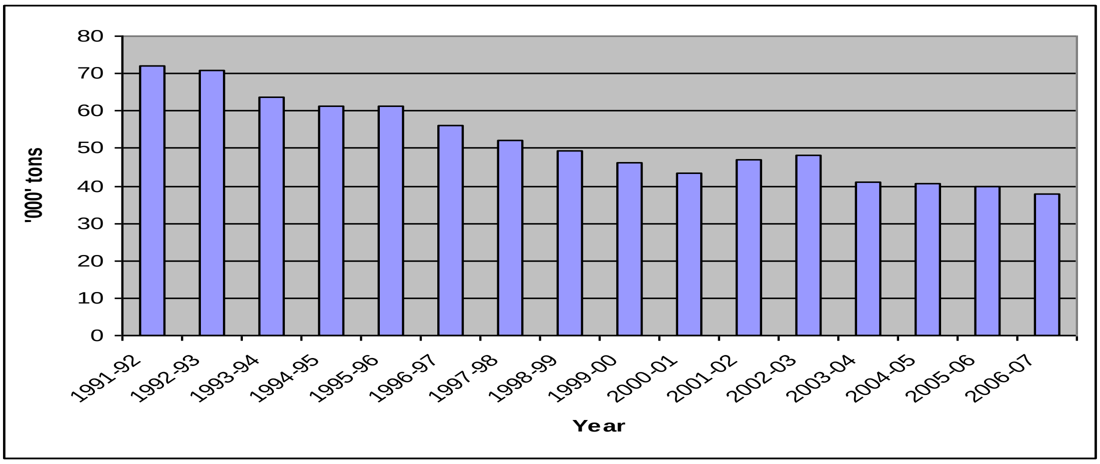


Fig 1.4 Consumption of pesticides in India, 1991-92 to 2006-07
(Source: www.indiastat.com)

---

[3] Bio-magnification, also known as bio-amplification or biological magnification, is the increase in concentration of a substance, such as the pesticide DDT, that occurs in a food chain as a consequence of persistence (can't be broken down by environmental processes) or Food chain energetics or Low (or nonexistent) rate of internal degradation/excretion of the substance (often due to water-insolubility).

[4] Bio-concentration is a process that results in an organism having a higher concentration of a substance than is in its surrounding environmental media, such as stream water. Bio-concentration differs from bio-accumulation because it refers to the uptake of substances into the organism from water alone. Bio-accumulation is the more general term because it includes all means of uptake into the organism.

The total consumption of pesticides in India has come down from 72.13 to 37.95 thousand tones between the period 1991-92 and 2006-07. There was a significant decline (almost half) in the consumption of total pesticides in the country over a span of 15 years. The reduction in the consumption may be due to the introduction of IPM technologies and conduct of awareness programs by the Department of Agriculture, Government of India.

But, according to AICRPPR report, 1999 - Pesticide Safety: Evaluation and Monitoring identified only 2 per cent of food commodities worldwide were found to be above MRL, but in India this figure was as high as 20 per cent. In states like Uttar Pradesh and Kerala, food samples exceeding MRL were as high as 46 per cent and 53 per cent respectively. In general, fruits and vegetables and milk are India's most contaminated food items.

Poison Report, Down to Earth, Vol 12, No 15 December 31, 2003

An analysis of India's research trends reveals two interesting facts. While there was substantial and rigorous research on pesticide residues in the 1960s and 1970s, research frequency started to drop from the late 1980s and became non-existent in the 1990s. Could this be due to the pesticide industry's growing clout? Or did government give up the regulatory ghost? Secondly, less research is made public. Pesticide residue analysis is treated as a classified secret? But the last report AICRPPR published was in 1999. No data has been made available since. Why? Are scientists now collaborators in poisoning India?

Track record

Summary data showing contamination of different food commodities in India (1965-1998)

Food item	Samples analyzed	Samples contaminated	Contamination (per cent)
Wheat	1,352	628	46.4
Rice	463	405	87.4
Sorghum	137	52	37.9
Pulses	487	211	43
Vegetables	6,803	3,642	53.5
Major vegetables*	2,930	1,659	56.62
Fruits	458	192	42
Spices	284	183	71.5
Honey	148	135	91.2
Total	13,062	7,107	54.4

*Tomato, okra, cabbage, brinjal, capsicum, potato, cauliflower
Source: G S Dhaliwal and Balwinder Singh (eds) 2000, Pesticides and Environment, Commonwealth publishers, New Delhi, p 207

With the pressures from Green Revolution, two major distortions have occurred in the food basket. They are the disappearance of traditional food crops (ragi, foxtail millet and banyard millet) and loss of nutrients from our food dishes. The changes in the eating habits are pronounced in more nutrition deficiencies (Shiva *et al.*, 2001; Shetty, 2002). Modern/conventional agriculture practices have adversely affected the quality of our food supply. Growing foods with methods designed to increase production or to facilitate transportation and storage is often detrimental to their nutritional value. Organic foods have been shown to have a higher nutritional value than conventionally grown foods (Shiva *et al*., 2004)

The above problems in modern/conventional farming coupled with liberalization and globalization of markets have aggravated the crisis in Indian agriculture. The impact of these have translated in to high costs of production and collapsing prices for farm produce is basis for "suicidal economy" where thousands of farmers committed suicide across the country. It has been witnessed in each and every corner of the country. There were at least 16,196 farmers' suicides in India in 2008, bringing the total since 1997 to 199,132, according to the National Crime Records Bureau (NCRB). The share of the Big 5 States or 'suicide belt' in 2008 - Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, and Chhattisgarh - remained very high at 10,797, or 66.6 per cent of the total farm suicides in the country (Sainath, 2010). The epidemic of farmer's suicide is the real barometer of the stress under which Indian agriculture and farmers have been put by globalization (Shiva *et al*., 2000).

Further, it is also proved that modern agriculture cannot be sustainable in long run because of the adverse changes being caused to the environment and the ecosystem (Kaiser, 2004; Ghosh, 2004). These implications are also experienced by declining crop yields and instability in crop production (Chand *et al*., 2008). The necessity of having an alternative agriculture method which can function in friendly eco-system while sustaining and increasing the crop productivity is realized now. Organic farming is recognized as the best known alternative to the modern/conventional agriculture. Due to the rising input costs involved in modern farming and its un-sustainability due to overcapitalization has made organic farming a necessity in many agriculturally grown regions (Singh, 2009). Organic farming has been found to be as or more viable than conventional farming in the USA and European countries due to either higher yield or lower cost or higher market prices (Lampkin, 1994). Modern organic techniques have the potential to stabilize and even increase sustainable farm yields with increasing soil fertility, environmental sustainability and preserving biodiversity of the ecosystem. It will also increase the nutritional value of the produce and reduces the pesticide residues in it.

Potential benefits of organic farming

The major problem in India is the poor productivity of our soils because of the low content of the organic matter. The efficiency of the organic inputs in the promotion of productivity depends on the organic contents of the soil. There were many resemblances of organic farming principles in the traditional agriculture of India. But the former gives a more open and verifiable scientific foundation than the latter (Table 1.1). Natural plant nutrients from green manures, farmyard manures, composts and plant residues build organic content in the soil. It is reported that soil under organic farming conditions had lower bulk density, higher water holding capacity, higher microbial biomass carbon and nitrogen and higher soil respiration activities compared to the conventional farms (Sharma, 2003). This indicates that sufficiently higher amounts of nutrients are made available to the crops due to enhanced microbial activity under organic farming. Several indirect benefits from organic farming are available to both the farmers and consumers. While the consumers get healthy foods with better palatability and taste and nutritive values, the farmers are indirectly benefited from healthy soils and farm production environment.

Table 1.1 Benefits of organic farming

Parameter	Potential benefits
Agriculture	Increased diversity, long-term soil fertility, high food quality, reduced pest/disease, self-reliant production system, stable production
Environment	Reduced pollution, reduced dependence on non-renewable resources, negligible soil erosion, wildlife protection, resilient agro-ecosystem, compatibility of production with environment
Social conditions	Improved health, better education, stronger community, reduced rural migration, gender equality, increase employment, good quality work
Economic conditions	Stronger local economy, self-reliant economy, income security, increase returns, reduced cash investment, low risk
Organizational/institutional	Cohesiveness, stability, democratic organizations, enhanced capacity

Source: Singh, 2009, Stoll, 2002, Crucefix, 1998

The important event in the history of the modern nascent organic farming in India was the unveiling of the National Programme for Organic Production (NPOP) in 2000. Later, Department of Agriculture and Cooperation, Ministry of Agriculture has also launched a central sector scheme entitled “National Project on Organic Farming (NPOF)” during Xth Five year plan. It includes capacity building through service providers; financial support to different production units engaged in production of bio-fertilizers, fruit and vegetable waste compost and vermi-hatchery units and human resource development through training on certification and inspection, production technology etc. The establishment of production units under this scheme is being provided as credit-linked and back-ended subsidy by NABARD and NCDC.

1.3 Scope of the study

Broadly, the present study has been planned to cover five major issues. First, an overview of organic farming in the World and in India and SWOT analysis of organic farming to articulate, refine, redefine policy prospective and schemes. What are the under lying issues and conceptual framework are also briefly examined. Second, what is the capacity utilization and efficiency of production units sanctioned under NABARD and NCDC? What are the main attributes of promoters and units affecting this efficiency? Policies related to training and subsidies and their impact on efficiency are also analyzed. Third, what are the constraints in establishment of units and identification of problems in marketing of organic inputs? Fourth, examine the constraints in procurement and usage of organic inputs by organic farmers. What are the suggestions for effective implementation of the project are discussed. Finally fifth, what is the economics and efficiency of organic farming in different states? Factors influencing efficiency of these farms are also discussed.

Limitations of the study

Since the study has covered only four state of India, the results can not be generalized to other states.

1.4 Plan of the study

The study is organized into eight chapters. Chapter 2 reviews the status of organic farming in the World and India, SWOT analysis of organic farming and briefly reviews the government policies in India. Chapter 3 gives the present status of organic input production in India. In Chapter 4 discuss about brief review of literature, analytical framework and specification of DEA model. Empirical results including productivity and efficiency of sample units are examined. Costs and returns of vermi-compost production across different states and regions are compared. Problems in establishment of units and constraints in production are summarized. Finally, suggestions for promoting of organic input production units are discussed.

In Chapter 5, examine the eight cases on three types of organic input units. Chapter 6 highlights the different marketing channels exists for marketing of organic inputs, nature of organic input demand and intensity of demand are scrutinized. The problems in procurement and usage of organic inputs are discussed. Chapter 7 analyzes the economics and efficiency of organic farming vis-à-vis conventional farming. Factors influencing efficiency and suggestions for further strengthening of organic farming in India are discussed. Finally, the main findings of the study, conclusions and policy implications are summarized in Chapter 8.

****

Chapter II

An Overview of Organic Farming

Household and national food security are complex and complicated goals influenced by many factors such as technologies, human capacities, policies, prices, trade and infrastructural context. Demand for food is certain to increase with increasing population pressure and income, even though this demand and ability to supply the demand are not equal in all communities. Indeed, today's total global agricultural production is just sufficient to feed the current world population with both necessary technologies and multilateral environmental agreements are available to help meet development and conservation needs. However, hunger, poverty and environmental degradation persist even as concerns about global human security issues continue to increase. Moreover, the last decades provide uncompromising evidence of diminishing returns on grains despite the rapid increases of chemical pesticide and fertilizer applications (Sanders, 2006), resulting in lower confidence that these high input technologies will provide for equitable household and national food security in the next decades. Overall, global cereal output is declining, mainly among the major producing and exporting countries (FAO, 2007).

Organic farming is an alternative way to overcome the problems of sustainability, global warming and food security. Organic production systems are based on specific standards precisely formulated for food production and aim at achieving agro ecosystems, which are socially and ecologically sustainable. Organic agriculture has developed and guidelines have been detailed over the last 50 years. Since the early 1990s, the term 'organic agriculture' has become legally defined in a number of countries. It has its roots in various terms, biodynamic, regenerative agriculture, nature farming and permaculture movements which developed in different countries. Numerous adaptations of the guidelines have taken place, but the common understanding is that:

Codex Alimentarius Commission, a joint body of FAO/WHO defines "organic agriculture as holistic food production management systems, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system". In its simplistic form organic agriculture may be defined as a kind of diversified agriculture wherein crops and livestock are managed through use of integrated technologies with preference to depend on resources available either at farm or locally. It also emphasizes more on optimizing the yield potential of crops and livestock under given set of farming conditions rather than maximization.

The International Federation of Organic Agriculture Movements (IFOAM) has formulated four broad principles of organic farming, which are the basic roots for organic agriculture growth and development in a global context. These principles of organic agriculture serve to inspire the organic movement in its full diversity. The principles are to be used as a whole, which are composed as ethical principles to inspire action. They are:

1. ***Principle of Health****:* Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but the maintenance of physical, mental, social and ecological well-being. Immunity, resilience and regeneration are key characteristics of health. In particular, organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well-being.

2. ***Principle of Ecology****:* Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help to sustain them. Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

3. *Principle of Fairness*: Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

4. *Principles of Care*: Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. It should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

Biodynamic agriculture was the first form of organic farming pioneered in tropical regions in 1929 when a German farmer started to produce Demeter coffee in Mexico. Other examples followed in New Zealand, Australia and Africa, all of them initiated by European pioneers (Kotschi, 2000). All these individual initiatives had no links to local farmers at that time. These have started to develop around the mid-1980s when representatives from emerging NGOs had opportunities to learn about sustainable and organic farming through development cooperation programmes. Once the agro-ecological farming techniques had developed to a certain maturity and confidence, farmers also wanted to reap economic benefits from these farming systems. A number of NGOs from developing countries have observed the organic markets in the North and considered organic as one possible strategy to add more economic value to the crops which are already cultivated close to organic principles. Value addition through a price premium was a key argument for them to pursue organic agriculture instead of the sustainable agriculture approach. In general, the pioneering stage in developing countries was induced by NGOs, sometimes in cooperation with small-scale export opportunities and fair trade schemes. These schemes primarily attempt to reduce poverty through increasing local and household food security and incomes.

In India, organic farming is not new to farming community. Several forms of organic farming are being successfully practiced in diverse climate, particularly in rain fed, tribal, mountains and hill areas of the country. Much of the forest produce of economic importance like herbs, medicinal plants, etc., by default come under this category. Among all farming systems, organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons. In our country, first the Spice Board of India has taken a major initiative in promoting the production and export of organic spices in a big way. To boost this sector, the project 'Empowerment of rural communities to export organic spices' was initiated. This project has been implemented by the Indian Spice Board, four NGOs, the International Trade Centre, and exporters. Around 1500 tribal persons and families got benefited from program (Fock, 2001; ISB, 2001).

Myths and reality about organic farming

There are several apprehensions about organic farming in mindset of scholars and researchers itself. A large number of debates are going on between the proponents of organic farming and a section of the community who questioned the scientific validity and feasibility of organic farming.

The most common question one would expect is about food security issue in the world. But, today organic agriculture is based on a sophisticated combination of traditional knowledge, modern science, and innovation. Therefore, adopting organic agriculture doesn’t mean going back to the pre-industrial yields of our great-grand parents. Many studies carried out in several parts of the world actually show that organic farms can be almost as productive as conventional farms (in developed countries) and sometimes even more productive (especially in developing countries). A 21-year long study carried out in Switzerland by the FiBL (*Forschungsinstitut für biologischen Landbau*) Institute showed that the yields in organic farming are only 20 percent less than in conventional farming. Reviewing more than 200 studies carried out in the US and Europe, Per Pinstrup Andersen (Professor at Cornell University and winner of the World Food Prize) and his colleagues reached the conclusion that yields in organic agriculture are around 80 percent of conventional yields. Another study reviewing a global dataset of 293 examples found that in developed countries organic systems, on average, produce 92 percent of the yields produced by conventional agriculture (Badgley *et al*, 2007).

The second most important question one would ask is regarding the labor intensive nature of organic farming. It is true that organic farming is often more labor intensive than conventional agriculture. For instance, organic agriculture encourages the maintenance of soil fertility through methods (such as compost and manure application and anti-soil erosion landscaping) which are labor intensive. In developing countries, these practices are generally performed by hand or with limited technologies, which imply the availability of an adequate workforce. However, in many areas of the World, land and capital (rather than labor) are the limiting factors. In most developing countries labor tends to be cheaper than chemical inputs (such as fertilizers and pesticides). In fact, there are many a range of labor saving technologies and methods that can be applied in the developing countries. They include use of cover crops to control of weeds and protect against soil erosion, the use of direct mulching with crop residues, and reduced tillage. For example, if properly managed, green manure/cover crops can produce from 50 to 140 ton/ha (green weight) of organic matter with limited work (IFOAM, 2008)

The third question is related to its relevance to Indian farming system. Yes, India has high comparative advantage in organic food production to compete in the international market. Only 35% of India's total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 65% of arable land, which is mainly rain-fed, negligible amount of fertilizers are being used. Farmers in these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The north-eastern region of India provides considerable scope and opportunity for organic farming due to least utilization of chemical inputs. It is estimated that 18 million hectare of such land is available in the North-East, which can be exploited for organic production. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the World's organic market. Need is for putting up a clear strategy on organic farming and its link with the markets (Ramesh *et al.,* 2005)

2.1 Status of organic farming in the World

Organic agriculture is developing rapidly, and statistical information is now available from 138 countries of the World. Its share of agricultural land and farms continues to grow in many countries. According to the latest survey on organic farming worldwide, almost 30.4 million hectares are managed organically by more than 700'000 farms (2006). In total, Oceania holds 42 percent of the World's organic land, followed by Europe (24 percent) and Latin America (16 percent). Currently (as of the end of 2006), the countries with the greatest organic areas are Australia (12.3 million hectares), China (2.3 million hectares), Argentina (2.2 million hectares) and the US (1.6 million hectares) (Fig 2.1). The proportion of organically compared to conventionally managed land, however, is highest in the countries of Europe. On a global level, the organic land area increased by almost 1.8 million hectares compared to the consolidated data from 2005. Almost all continents, the area under organic agriculture has grown up. The largest growth was in Oceania/Australia with 0.6 million hectares, followed by Europe where the organic area increased by half a million hectares and Asia with 0.4 million hectares. The global survey on organic farming was also collected data on certified organic wild collection (Fig 2.2). Thirty-three million hectares are certified for wild harvested products (2006). The majority of this land is in developing countries – quite the opposite of agricultural land, of which more than two thirds is in industrialized countries (FiBL Survey, 2008) (Fig 2.3).

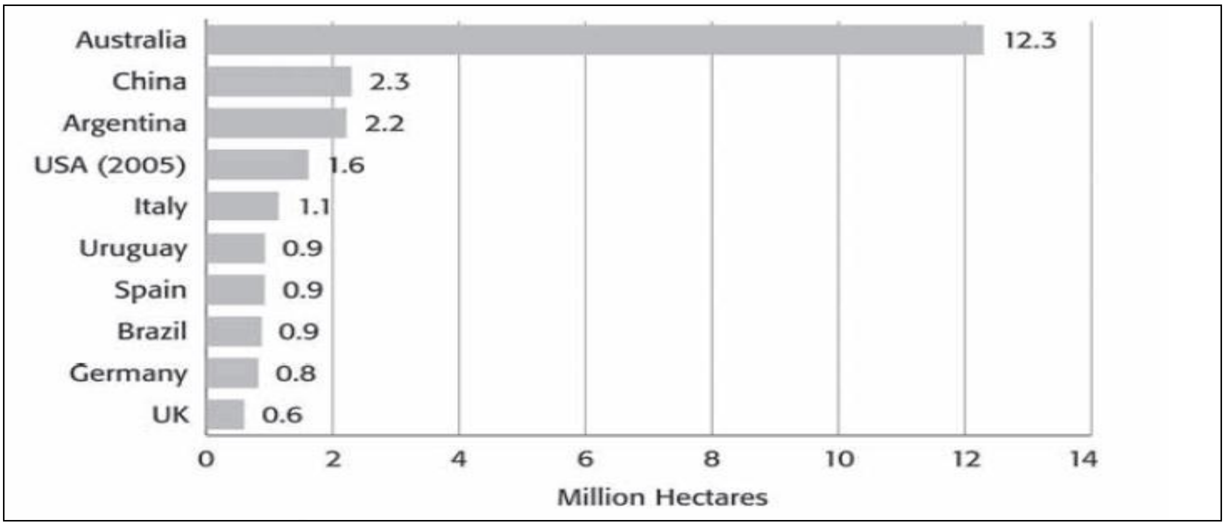


Fig 2.1 Top ten countries with organic land (FiBL Survey, 2008)

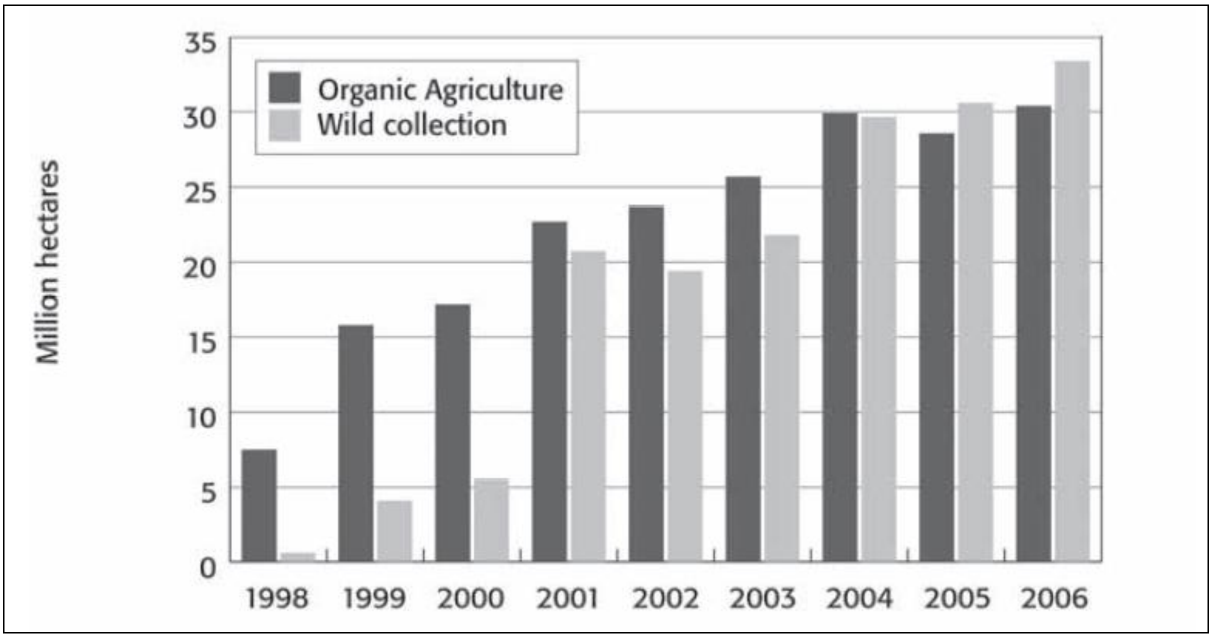


Fig 2.2 Development of certified organic land worldwide, 1998-2006

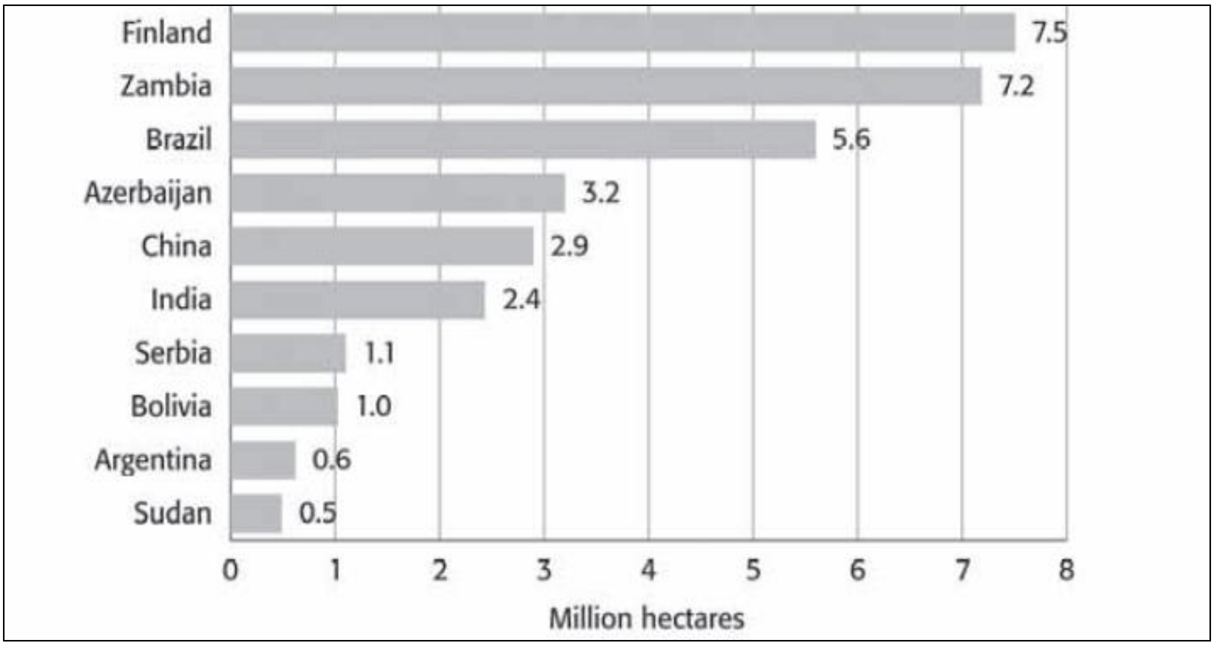


Fig 2.3 Top ten countries with largest wild collections, 2006

Global demand for organic products remains robust, with sales increasing by over five billion US Dollars a year. Organic Monitor estimates international sales to have reached 38.6 billion US Dollars in 2006, double that of 2000, when sales were at 18 billion US Dollars. Consumer demand for organic products is concentrated in North America and Europe; these two regions comprise 97% of global revenues. Asia, Latin America and Australia are also important producers and exporters of organic foods. The global organic food industry has been experiencing acute supply shortages since 2005. Exceptionally high growth rates have led supply to tighten in almost every sector of the organic food industry. The most important import markets for organic products are the European Union, US and Japan, and thus their regulations have a significant impact on global trade and the development of standards in other regions.

Today, around 468 organizations worldwide offer organic certification services (table 2.1). Most certification bodies are in Europe (37 percent), followed by Asia (31 percent) and North America (18 percent). The countries with most certification bodies are the US, Japan, South Korea, China and Germany. Currently, 36 certification bodies have received IFOAM accreditation by the International Organic Accreditation Services (IOAS), which assesses certification bodies against the IFOAM norms.

Table 2.1 Countries with number of certification bodies

	2007	2006	2005
USA	60	59	60
Japan	55	35	69
South Korea	33	2	1
China P.R.	32	32	26
Germany	32	31	31
Spain	28	26	25
Canada	23	21	24
Brazil	21	18	18
Italy	16	16	16
India	12	11	9
United Kingdom	10	10	10
Austria	9	9	9
Australia	7	7	7
Poland	7	7	6

Source: Organic Certification Directory, 2007 (Grolink, 2007)

Asia statistics

The total organic area in Asia is nearly 3.1 million hectares, managed by almost 130’000 farms (table 2.2). This constitutes ten percent of the world’s organic agricultural land. The leading countries are China (2.3 million ha), India (528’171 ha) and Indonesia (41’431 ha). The highest shares of organic land of all agricultural land are in Timor Leste (6.9 percent) followed by Lebanon (1 percent), Sri Lanka and Israel (0.7 percent). Wild collection plays a major role in Azerbaijan, India and China (all with more than one million hectares).

The Asian market continues to show high growth in terms of organic food production and sales. Organic crops are grown across the continent, with some countries becoming international suppliers of organic commodities. Retail sales were about 780 million US Dollars in 2006 (Organic Monitor). Demand is concentrated in Japan, South Korea, Singapore, Taiwan and Hong Kong, the most affluent countries in the region. Organic regulations have been established in eleven Asian countries, and another eight countries are in the process of drafting organic regulations. Israel and India have attained equivalency status with the EU regulation on organic farming.

Table 2.2 Organic agricultural area and farms in Asia, 2006

Country	Organic agricultural area (ha)	Share of agricultural land	Farms
Armenia	235	0.02%	35
Azerbaijan	20'779	0.44%	388
Bhutan	243	0.04%	53
Cambodia	1'451	0.03%	3'628
China	2'300'000	0.41%	1'600
Georgia	247	0.01%	47
Hong Kong (2005)	12	No data	20
India	528'171	0.29%	44'926
Indonesia	41'431	0.09%	23'608
Iran	15	0.00%	2
Israel	4'058	0.71%	216
Japan	6'074	0.16%	2'258
Jordan	1'024	0.09%	25
Kazakhstan	2'393	0.00%	No data
Korea, Republic of	8'559	0.45%	7'167
Kyrgyzstan	2'540	0.02%	392
Lebanon	3'470	1.02%	213
Malaysia	1'000	0.01%	50
Nepal	7'762	0.18%	1'183
Pakistan	25'001	0.10%	28 (2004)
Palestine	641	0.19%	303
Philippines	5'691	0.05%	No data
Saudi Arabia (2005)	13'730	0.01%	3
Sri Lanka	17'000	0.72%	4'216
Syria	30'493	0.22%	3'256
Taiwan (March 2007)	1'746	0.21%	905
Thailand	21'701	0.12%	2'498
Timor Leste	23'589	6.94%	No data
Vietnam	21'867	0.23%	No data
Total	3'090'924	0.17%	97'020

Source: FiBL Survey, 2008

Developing countries statistics

More than one quarter of the World's organic land is in developing countries (8.8 million hectares). Most of this land is in Latin America followed by Asia, Africa and Europe. The leading countries in terms of organic land are China, Argentina, Uruguay and Brazil. The highest percentages of organic land are in several Pacific Island countries, East Timor, Uruguay and Argentina; in these countries, the shares of organic land of all agricultural land are comparable to those in Europe. These high shares can probably be attributed to a high potential for exports and to several support activities in these countries. Out of the developing countries covered by the survey, only few have a higher share of organic land than one percent of the agricultural area. Thus, compared to developed countries, organic farming lags behind (Fig 2.4)

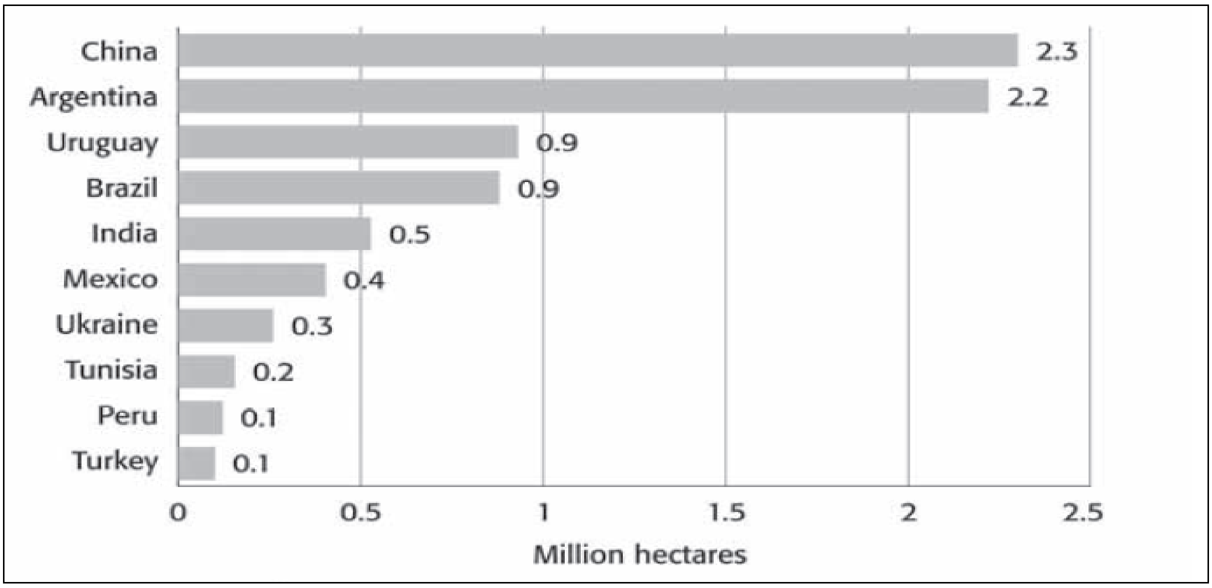


Fig 2.4 Top ten developing countries with organic land (FiBL Survey, 2008)

As per 2008 global survey, the organic land use details were available approximately for 95 per cent of the total area. A total of 4.45 million ha arable land accounts for one sixth of the organic agricultural area. Most of the World's organic arable land is in Europe, followed by North America and Asia. Most of the arable land is used for cereals, including rice, followed by field fodder crops. Permanent crops account for five percent of the organic agricultural land (1.5 million hectares). Most of this land is in Europe, followed by Latin America and Africa. The most important crops are olives (almost a quarter of the permanent cropland) followed by coffee, fruits and nuts.

Permanent pastures / grasslands (more than 20 million hectares) account for two third of the World's organic land area. More than half of this grassland is in Australia.

2.2 Status of organic farming in India

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. Currently, India ranks 33rd in terms of total land under organic cultivation and 88th position for agriculture land under organic crops to total farming area. The cultivated land under certification is around 2.8 million ha (2007-08, 1.9% of the GCA). This includes 1 million ha under cultivation and the rest is under forest area (wild collection) (APEDA, 2010).

The organic land area has increased substantially between 2005 and 2006 and is now more than 500'000 hectares. Indian government has acquired both the USDA equivalence for the NOP and the EU third country listing in 2006. Furthermore, recognizing the difficulty smallholders face to access third party certification, the government launched a national Participatory Guarantee System (PGS) program, with the support of the FAO India office to facilitate organic assurance. The government is also implementing a National Project on Organic Farming (NPOF) for production, promotion, certification and market development of organic farming in the country. Financial assistance is being provided for the capacity building through service providers, setting up of organic input production units, promotion of organic farming through training programs, field demonstrations, setting up of model organic farms and market development.

India produced around 3,96,997 MT (2007-08) of certified organic products which includes all varieties of food products namely Basmati rice, Pulses, Honey, Tea, Spices, Coffee, Oil Seeds, Fruits, Processed food, Cereals, Herbal medicines and their value added products (table 2.3). The production is not limited to the edible sector but also produces organic cotton fiber, garments, cosmetics, functional food products, body care products etc. The commodity wise details of quantity exported and its value is presented in table 2.4.

Table 2.3 Organic food production in India, 2007-08

Total production	9,76,646 M.T.
Total quantity exported	37,533 M.T
Value of total export	USD 100.4 million
Total area under certification (including wild harvest)	2.8 million hectares
Total area under certified organic cultivation	0.45 million hectares
Share of exports to total production	4% approx.
Increase in export value over previous year	30% approx.

Source: APEDA, 2010

Table 2.4 Commodity wise organic food exports, 2007- 08

Commodity	**Export Contribution** (of volume)	**Export Contribution** (of value)	**Export Contribution** (Rs. Cr)
Cotton	43%	25%	123.88
Basmati Rice	15%	13%	59.20
Honey	11%	10%	46.41
Tea	8%	20%	92.13
Dry fruits	7%	18%	84.31
Processed food	5%	4%	17.99
Sesame	4%	2%	9.13
Spices	3%	4%	20.09
Medicinal & Herbal plants/products	2%	2%	10.59
Others	2%	2%	5.05

Source: APEDA, 2010

India exported 86 items last year (2007-08) with the total volume of 37533 MT. The export realization was around 100.4 million US $ registering a 30% growth over the previous year. Organic products are mainly exported to EU, US, Australia, Canada, Japan, Switzerland, South Africa and Middle East. Cotton leads among the products exported (16,503 MT). According to the Indian Centre for Organic Agriculture (ICCOA), a major reason for the growth in organic farming is increased awareness among consumers in the country, even though until recently food was mainly being exported. But over the last couple of years, the domestic market has started growing.

2.3 SWOT analysis of Organic farming

A scan of the internal and external environment is an important part of the strategic planning process. Environmental factors internal to the firm usually can be classified as strengths (S) or weaknesses (W), and those external to the firm can be classified as opportunities (O) or threats (T). Such an analysis of the strategic environment is referred to as a SWOT analysis. The SWOT analysis provides information that is helpful in matching the firm's resources and capabilities to the competitive environment in which it operates. As such, it is instrumental in strategy formulation and selection.

The main focus of this section is to assess the Strengths, Weaknesses, Opportunities and Threats (SWOT) of organic farming mainly in the Indian context. Several studies conducted on organic farming by different researchers are very precise and need based. An attempt was made to consolidate all these researches conducted in India and abroad and tried to present them in a systematic body of knowledge. This appraisal would give a clear understanding of facts about organic farming and its relevance to Indian situation.

The present Indian organic market is a typical example of a market in the pre-growth phase, suffering from the incertitude about the potential market, lack of successful pioneers and courageous imitators, and incertitude about positioning. Typical nature of the pre-growth-phase of an organic market is the incertitude of consumers and many stakeholders. The unique selling proposition (USP) of organic products and the differences from the conventional production are not clearly defined yet. The awareness about the residual effects of pesticides is good in some states and in the agglomeration of cities and metropolis of India. This awareness is a very important factor in the assessment of the present status. Actually, some products that are sold as products “with less pesticide” are available in the market but law in India does not protect the term "organic". If we don’t take the export market into consideration, the situation of the domestic market is in some aspects similar to the situation in Switzerland or EU in the beginning of the nineties; especially regarding the aspects of awareness, implementation of national guidelines and distribution. All documented trends about the Indian food-market or the Indian society are an encouraging sign for further development of the organic products. Particularly, the fact that Indian economy is expanding rapidly, is very positive for the domestic market. The summary of SWOT analysis on organic farming is presented in table 2.5.

Table 2.5 Summary of SWOT analysis on organic farming

Strengths	**Weaknesses**
• Safety food • Comparative advantage in organic food production • Low cost of production • High quality and improved nutrition • Improved soil health • Premium prices • Environmental sustainability • High water-use efficiency • Government policies (like NPOP) • Preserves traditional varieties/species and high self-life	• Productivity gaps • Lack of established markets • Poor quality management in production and processing • Less incentives from Government • Low R&D investments on Organic farming research • Organic market buyers/consumers driven market • Lack of strategy for development of organic market • Disjointed producers, processors and traders • Adulteration and poor quality of organic inputs • Large number of small farms with weak organizational building • Intensive in nature and high labor costs
Opportunities	**Threats**
• Big and growing market potential • Growing purchasing power of consumers • Growing health awareness • 70% of GCA is under rain fed agriculture • Reduce heavy subsidies on food and fertilizers • Control the nitrate losses and Co_2 emissions • Earn high export earnings	• High cost of organic food • Costly and complex organic certification process • Lack of infrastructure facilities (like labs) and certification bodies • Only export regulated organic market • Low awareness about organic inputs • Most of the fields are contiguous and problem of contamination • Introduction of GM crops

2.3.1 Strengths

Organic farming has much strength than modern/conventional farming practices globally and in particularly in India. These strengths have been validated by several studies and researchers in the last one decade. The important strengths are:

2.3.1.1 Safety food

Generally, consumers attribute positive qualities and characteristics to organic foods. Such attributions include the following: healthy, tasty, authenticity, “lives up to its promise”, local, highly diverse, fresh, low in processing, whole food, natural, free from pesticides, antibiotics, low in nitrate content, safe and certified. Organic plant products contain markedly fewer value-reducing constituents (pesticides, nitrates); this enhances their physiological nutritional value. They are just as safe as conventional products as regards pathogenic microorganisms (mycotoxins, coli bacteria). These products tend to have lower protein content and higher vitamin C content.

Health claims are generally not substantiated by scientific research, even in cases where the organic production system provides inherent nutritional advantages (e.g. higher contents of bioactive compounds in fruits and vegetables or higher contents of fat-soluble vitamins or polyunsaturated fatty acids in organic milk or meat). These findings were also verified by other studies in UK. Nutritionally desirable CLA, omega-3 fatty acids, vitamin E and carotenoids were increased in milk from organic farms with grazing dairy cows. These compounds have all been linked to a reduced risk of cardiovascular disease and cancer. By contrast, less desirable fatty acids (i.e. omega-6 fatty acids and CLA10) were not increased in organic milk, which helps to improve the crucial ratio between the two (Niggli *et al., 2008).*

Rekha *et al* (2006) conducted a study to verify the pesticide residues on different organic farms as well as on market samples (conventional farms). Four groups of pesticides, i.e., organochlorine, carbamates, organophosphorous and pyrethrites were analyzed in wheat and rice samples. Presence of organochlorine pesticide residue was observed in two out of ten organic farms, which were converted from conventional to organic practices few years ago. This was attributed to excessive use of synthetic pesticides. Wheat and rice samples taken from market (conventional farm) showed significant level of pesticide residues (table 2.6). Method used for extraction of pesticides was validated with recovery studies, which showed more than 80% recoveries for organochlorine, organophosphorous, carbamates and pyrithroids respectively.

Table 2.6 Pesticides residues in different market samples

	Pesticide Residue (mg/L)	
Name of Pesticide	Rice	Wheat
Organochlorine (endosulfan)	0.02	0.3
Organophosphorous (phorate)	0.04	0.024
Carbofuran	4.85	–
Permethrin	0.02	0.05

2.3.1.2 Comparative advantage in organic food production

India is strong in high quality production of certain crops like tea, some spices of rice specialties, ayurvedic herbs etc. India also has a rich heritage of agricultural traditions that are suitable for designing organic production systems (table 2.7). Sophisticated crop rotation or mixed cropping patterns, for example the famous agro-forestry systems of the Western Ghats, facilitate the management of pests, diseases and nutrient recycling. Botanical preparations, some of which originate from the ancient veda scripts, provide a rich source for locally adapted pest and disease management techniques. The widespread cultivation of legume crops facilitates the supply of biologically fixed nitrogen. In several regions of Indian agriculture is not very intensive as regards the use of agro-chemicals. Especially in mountain areas and tribal areas, use of agrochemicals is rather low, which facilitates conversion to organic production. On these marginal soils, organic production techniques have proved to achieve comparable or in some cases (especially in the humid tropics) even higher yields than conventional farming. Compared to input costs, labor is relatively cheap in India, thus favoring the conversion to less input-dependent, but more labor-intensive production systems, provided they achieve sufficient yields, where farmers have access to established organic markets within the country or abroad, products can achieve a higher price compared to the conventional market. Especially in the trend of decreasing prices for agricultural products, this can be an important way to stabilize or even increase incomes.

Table 2.7 Crops for which comparative advantage in production

Product	Season	States	Major Locations
Tea	Throughout the year	Assam, West Bengal, Uttranchal	Darjeeling, Guwahati, Dehradun
Spices	Throughout the year	Kerala, Tamil Nadu, Karnataka	Cochin, Coimbatore, Idduki, Coorg
Coffee	Throughout the year	Kerala, Tamil Nadu, Karnataka	Coimbatore, Coorg, Wayanadu, Peeremade
Rice	Kharif & Rabi*	Punjab, Haryana, Assam, Maharashtra, Tamil Nadu	Amritsar, Jalandhar, Darrang, Ratnagiri, Kanchipuram, Thiruvallur
Wheat	Kharif & Rabi	Punjab, Haryana, Uttar Pradesh	Ambala, Patiala, Bhatinda, Faridkot
Vegetables	Throughout the year	All India	Various locations
Fruits	Throughout the year	All India	Various location
Cotton	Kharif	Maharashtra, Gujarat Madhya Pradesh,	Akola, Amravati, Amreli, Kheda, Indore

Source: Salvador *et al*., 2003

2.3.1.3 Low cost of production

Organic agriculture has triggered a controversial debate in the last decade, most importantly because it shed light on the darker sides of chemical-intensive conventional farming by offering an alternative. As more and more attention has been put on determining whether organic systems are environmentally better or not, it is not clear whether organic agriculture could be economically attractive enough to trigger wide spread adoption. If organic farming offered a better environmental quality, and potentially healthier foods, but not sufficient economic returns to the majority of farmers, it would obviously remain a luxury way of food production available to a very tiny fraction of farmers. However, the continued growth of organically managed lands worldwide, especially in developing countries, does not support this hypothesis.

An Indo-Swiss research team compared agronomic data of 60 organic and 60 conventional farms over two years (Eyhorn *et al.*, 2005) and came to the conclusion that cotton-based organic farming is more profitable: variable production costs were 13-20 percent lower, inputs were 40 percent lower, yet yields were 4-6 percent higher in the two years, and as a consequence gross margins for cotton were also

30-43 percent higher. Although crops grown in rotation with cotton were sold without a price premium, organic farms achieved 10-20 percent higher incomes from conventional agriculture. Similarly, an impact assessment study for organic cotton farmers in Kutch and Surendranagar commissioned by Agrocel concluded that farmers who participated in the project enjoyed a net gain of 14-20 percent resulting from higher revenues and lower costs. The updated version of the study surveying 125 organic cotton farmers concluded that 95 percent of respondents witnessed their agricultural income raises after adopting organic agriculture, on average by 17 percent, most of them attributing this largely to the reduced cost of production and higher unit output prices (MacDonald, 2004). In conclusion, studies found organic cotton farming more profitable than conventional.

An energy analysis (gallons diesel per acre) of Rodale Institute's Farming Systems Trial (FST) showed a 33 per cent reduction in fossil-fuel usage for organic corn/soybean farming systems that use cover crops or compost instead of chemical fertilizers (fig 2.5). Moreover, Rodale Institute's organic rotational no-till system can reduce the fossil fuel needed to produce each no-till crop in the rotation by up to 75 percent compared to standard-tilled organic crops (Pimentel, 2006).

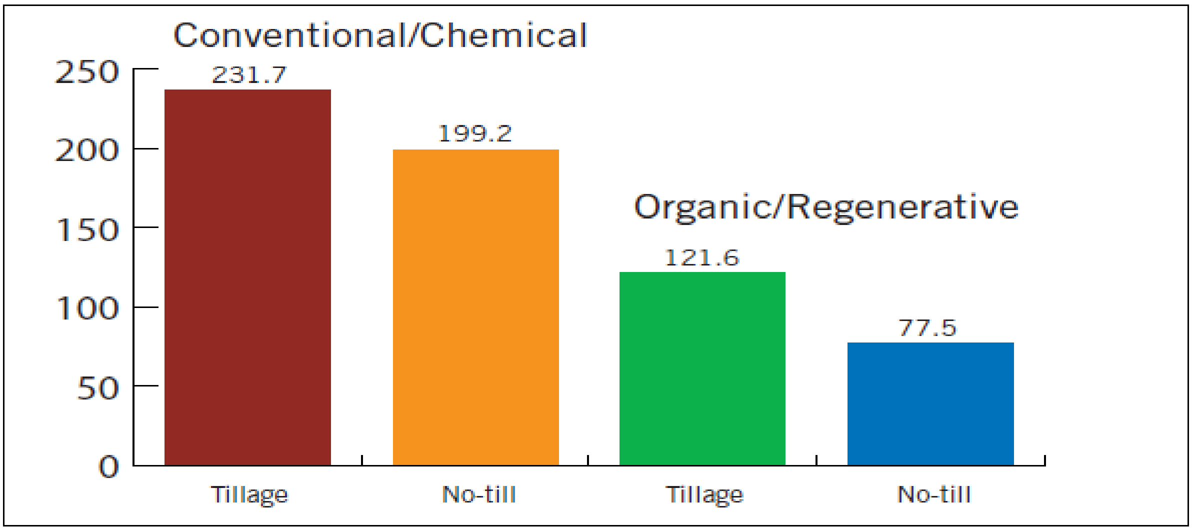


Fig 2.5 Energy usage in different corn production systems

2.3.1.4 High quality and improved nutrition

Growers and consumers of organic food products (raw vegetables and fruits, in particular) widely claim that organic food products have a better shelf life and taste.

Evidences suggest that food items produced using alternative sources of crop nutrients (i.e. without fertilizers) foods were more nutritious than those produced conventionally (Worthington 2001). Organic food products generally had more of vitamins, minerals and less of nitrates than those grown with conventional agricultural food. This aspect can contribute to the nutrition security of a nation and equally to its food security.

A study conducted by Campden Research Station in 2008 (Analytical survey of the Nutritional Composition of organically Grown Fruits and Vegetables) revealed that there are differences in nutritional status between organic and non-organic produce. The results are summarized in table 2.8.

Table 2.8 Differences in nutritional status between Organic and non-organic produce

Product	**Nutrients in organic food per 100 g**	**Nutrients in chemically produced food per 100 g**
Apples		
Sugars (total)	8.8 g	9.5 g
Vitamin C	21.6 mg	19.3 mg
Tomatoes after dehydration		
Sugars (total)	63.4 g	70.0 g
Tomatoes		
Vitamin C	21.8 mg	18.0 mg
Vitamin A	4.7 mg	3.5 mg
Tomatoes after dehydration		
Vitamin C	349 mg	288 mg
Vitamin A	7.3 mg	5.5 mg
Carrots		
Glucose	0.9 g	1.3 g
Potassium	269 mg	217 mg
Carrots after dehydration		
Sugars (total)	42.8 g	52.8 g
Potatoes		
Sugars (total)	0.7 g	0.8 g
Vitamin C	13.5 mg	17.8 mg
Potassium	329 mg	370 mg
Zinc	310 μg	260 μg
Potatoes after hydration		
Sucrose	1.0 g	2.4 g
Fructose	1.2 g	0.7 g
Glucose	2.0 g	1.2 g
Iron	5.7 mg	4.7 mg
Calcium	64.0 mg	56.4 mg
Zinc	1810 μg	1350 μg

2.3.1.5 Improved soil health

Scientific research has demonstrated that organic agriculture significantly increases the density and species of soil's life. Organic farming encourages the growth of soil fauna and flora as well as soil forming, conditioning and nutrient cycling. The biomass of earthworms in organic system is 30-40% higher than conventional system, their density even 50-80% higher. Earthworms can increase the availability of phosphorus from rock phosphate by 15-39 per cent. They act as mini-subsoilers, their burrows increasing soil aeration, drainage and porosity. The ratio of microbial carbon to total soil organic carbon is higher in organic farming. Microbial biomass and enzyme activities are closely related to soil acidity and soil organic matter content.

Reganold *et al* (1987) compared the long term effects (since 1948) of organic and conventional farming on selected properties of the same soil. The organically farmed soil had significantly higher organic matter content, thicker topsoil depth, higher polysaccharide content, lower modulus of rupture and less soil erosion than the conventionally farmed soil (table 2.9). This study indicated that, in the long term, the organic farming system was more effective than the conventional farming system in reducing soil erosion and therefore, maintaining soil productivity.

Table 2.9 Mean values of soil properties

Soil property	Organic farm	Conventional farm
Surface soil colour	10YR 4/2	10YR 5/2, 5/3
Polysacchride content (g kg^{-1} soil)	1.13*	1.00
Moisture content (%)	15.49†	8.98
Modulus of rupture (MPa)	1.61×10^{-2}	1.98×10^{-2}*
Surface texture	Silt loam	Silt loam
Subsoil (Bt) texture	Silty clay loam	Silty clay loam
Bulk density (mg m^{-3})	0.98	0.95
Surface (A1) horizon thickness (cm)	39.80*	36.68
Depth to argillic horizon (cm)	55.60†	39.80

Haas *et al*., (2005) conducted a study in Hamburg, Germany to estimate the environmental impact of conversion to organic agriculture by using a Life-Cycle Assessment (LCA) method. The projected nutrient-balance data of each system to the farmed area was calculated and presented in table 2.10. The ‘N’ surplus in conventional farming was twice as high as in the organic scenario. In organic agriculture, the ‘P’ and ‘K’ balances indicate a slight deficit. The ‘N’ surplus in conventional farming was as high as the ‘N’ input via mineral fertilizer, indicating an inefficient use, though higher yields and therefore nutrient outputs were achieved. No straw or roughage was imported from outside the study area. Therefore, in organic agriculture only a small amount of nutrients was imported via purchased feed (e.g., concentrates). Deficits for ‘P’ and ‘K’ in organic agriculture indicate that there is no environmental impairment (e.g., eutrophication). After converting to organic agriculture, no fertilization is needed for many years if previous conventional farming caused nutrient-rich soils, which still is often the case in many European countries.

Table 2.10 Regional nutrient balance scenario of conventional (Conv.) and organic farming (Org.)

[kg ha^{-1}]	Nitrogen		Phosphorus		Potassium	
	Conv.	Org.	Conv.	Org.	Conv.	Org.
N_2-fixation	15.4	44.2	-	-	-	-
Mineral fertiliser	95.0	-	14.3	-	50.2	-
Purchased feed	25.8	7.7	5.2	1.7	9.8	2.6
Animals	2.7	0.5	0.7	0.1	0.2	0.1
Atmospheric deposition	15.6	15.6	-	-	-	-
Input total	*154.5*	*68.0*	*20.2*	*1.8*	*60.2*	*2.7*
Sold crops	42.4	14.3	8.9	2.9	11.0	4.3
Sold animals	15.3	11.0	3.1	2.2	3.0	3.5
Output total	*57.7*	*25.3*	*12.0*	*5.1*	*14.0*	*7.8*
Balance remainder	*96.8*	*42.7*	*8.3*	*-3.3*	*46.2*	*-5.1*

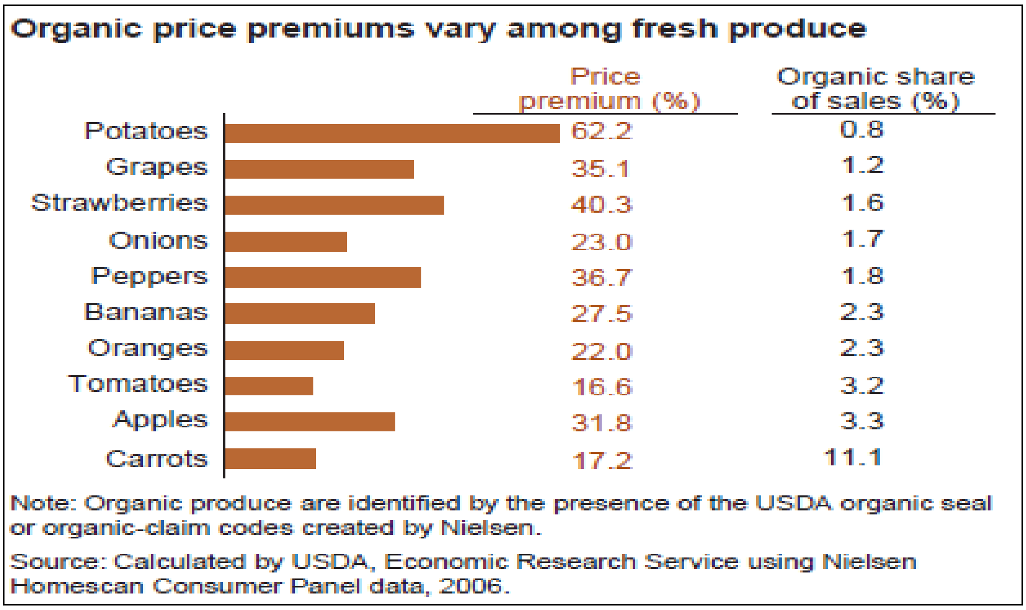
[1)] LU - livestock unit equals 500 kg live weight

2.3.1.6 Premium prices

Organic products often sell for higher prices than conventionally produced goods. The price premium results from higher production and distribution costs for organic food, as well as consumers' willingness to pay extra for organic food. As long as demand increases faster than supply and prices of conventionally produced food remain constant, organic food will continue to sell for higher prices. As farmers receive higher prices for their organic products, they increase production, and attract other farmers to the organic sector. At the same time, as the price differential between organically and conventionally grown products diminishes, more consumers are likely to purchase organic food. However, relative changes of supply and demand will determine whether price premiums continue for organic farmers and businesses. If supply begins to grow faster than demand, price premiums will decline.

Consumer willingness to pay Premium

Consumers are buying organic food despite its generally higher price tag. Retail sales of organic food increased from $3.6 billion in 1997 to $18.9 billion in 2007, accounting for over 3 percent of total U.S. food sales. According to the Nutrition Business Journal, organic food sales could reach an estimated $24 billion in 2010. Among the organic food categories, fruit and vegetable sales were the largest ($6.9 billion), almost 37 percent of organic sales in 2007.



Source: Biing H.L *et al., 2008*

2.3.1.7 Environmental sustainability

The success of agriculture in the technologically-advanced countries has been accompanied by a number of environmental problems. These problems have arisen because of the need for insecticides, herbicides, and fertilizers, and the local accumulation of large quantities of animal wastes. The less-developed nations have not achieved the same success in food production, and yet it is prudent for them to give attention even now to the environmental consequences of agricultural activities. They must initiate courses of action, so that there will be the least possible environmental perturbation as they come to rely more and more on pesticides and fertilizers. Both the advanced and the less-developed countries, however, must now devote considerable effort to minimizing salinization, erosion, and soil deterioration (Alexander, 1973).

Commissioned by the Ministry of Environment of Hamburg, Germany, an environmental impact assessment using the Life-Cycle Assessment (LCA) method was carried out during 1995-96 (table 2.11). The effect of a complete transition from conventional to organic agriculture of about 5,674 ha and 4,669 livestock units in a rural part of Hamburg was investigated using 9 impact categories. It was estimated for the study area for the year 1995 that through the conversion to organic agriculture, the eutrophication potential could be lowered by reducing the nitrogen (N) surplus by 75% (from 311 t to 77 t) and turning the phosphate (P) surplus of 47 t into a deficit of 19 t. The ammonia emission decreased to 69% of the conventional level (from 238 t to 165 t) resulting in a similar reduction of the acidification potential (from 474 t to 328 t SO2- equivalents). Compared to conventional farming, 55% of the primary energy was saved by organic agriculture (38,540 instead of 84,760 GJ), which also lowered the global warming potential by 31% from 26,365 t to 18,271 t CO2-equivalents. No pesticides were used, thus saving about 22.7 t of chemical agents. This would lead to positive effects in the impact categories drinking water quality, human toxicity and ecotoxicity, especially as most pesticides were applied illegally and not in compliance with the regulations regarding minimum distance to surface water. The biodiversity impact assessed by evaluating several indicators during field visits showed a clear improvement for arable land, permanent grassland and landscape structures (such as ditches and field boundaries).

Table 2.11 Environmental impact scenario comparing organic vis-à-vis conventional farming

Impact category	Environmental indicator	Reduction of ... if organic
Eutrophication potential	N-surplus without NH_3-emission P-balance NH_3-emission	75%: from 311 t to 77 t: from surplus of 47 t to a deficit of 19 t 31%: from 238 t to 165 t
Resource depletion	Energy use P-fertiliser use	55%: from 84,760 to 38,540 GJ 100%: from 81.1 t
Global warming potential	CO_2-equivalents (CO_2-, CH_4-, N_2O-emission)	31%: from 26,365 t to 18,271 t
Acidification potential	SO_2-equivalents (SO_2-, NH_3-, NO_x-emission)	31%: from 474 t to 328 t
Drinking water protection	N-surplus (to estimate nitrate contamination) Pesticide use	75%: from 311 t to 77 t 100%: from 22.7 t, no risk of contaminating any water body
Human toxicity (working environment)	Pesticide use	No risk of contamination for farmers
Biodiversity (incl. ecotoxicity)	Typical species diversity of biotopes, number of endangered species, endangered and typical plant associations, living conditions for fauna, pesticide use	Arable land: clear improvement Grassland: improvement Structures (ditches and boundaries): clear improvement
Landscape image (aesthetics)	Local landscape image description, diversity and visual effect of crops	No difference between organic and conventional
Soil protection	Accumulation of heavy metals, soil compaction, humus balance	No difference between organic and conventional farming

Source: Haas *et al*., 2005

2.3.1.8 High water-use-efficiency

Modern/conventional farming and Green Revolution are based on intensive irrigation and non-sustainable water use. Organic agriculture or indigenous agriculture depends on protective irrigation. Soil organic matter is a storehouse of plant nutrients and a binding agent that influences soil erodibility and moisture holding capacity. The water holding capacity (WHC) of modern/conventional farm ranged from 28-33% where as, in case of organic farm it ranged from 42-47% (Shiva *et al*, 2004). Diversity of crops and mixed cropping conserves moisture by reducing evaporation and improving water-use efficiency. Studies have been proved that HYV's of wheat needs about three times as much irrigation as traditional varieties. In general, indigenous wheat varieties need 12 inches of irrigation where as the hybrid varieties require at least 36 inches of water (Shiva *et al.*, 2004).

2.3.1.9 Government policies (like NPOP, NPOF)

The Indian Government has recognized the export potential of organic agriculture and is in the process of strengthening the sector by putting a legal framework in place. This includes creating national organic standards and the possibility of accrediting in-country inspection and certification bodies. National Programme of Organic Production (NPOP) launched by the Ministry of Commerce during 2001 and National Project on Organic farming (NPOF) launched during 2004 by the Department of Agriculture and Cooperation, Ministry of Agriculture were the two milestones towards institutionalization of organic farming.

Under NPOF, Government of India has initiated systematic promotion of organic farming in the country in a project mode in specified areas. The project is being operated by National Centre of Organic Farming (NCOF) and its six Regional Centers of Organic Farming (RCOF). Capacity building through service providers, human resource development through training and demonstrations, financial support to organic input production industry, technology development, awareness creation and market development are some of the important strategies being implemented under the NPOF. More than 400 Government and Non-Government agencies are working under the project. More than 300 farmers groups, each comprising of about 1500 farmers have started functioning to bring about 200,000 ha land under organic certification process. With support to many organic production units a capacity has been created to produce about 5000 MT of vegetable market waste compost, 3000 MT of bio-fertilizers and 78,000 MT of earthworm culture. 1848 trainings organized under the project have benefited more than 37,000 trainers, extension professionals and farmers. Besides above more than 4100 demonstrations have been conducted and support has been provided for the establishment of 232 model organic farms through out the country (NCOF, Ghaziabad)

2.3.1.10 Preserves traditional varieties/species

Seed is the embodiment of the ideas and knowledge of the culture and heritage of the people. Seed thus, represents the wisdom of the years of research of the farmers in that region. It is the first link in the food chain and is the ultimate symbol of food security as well. Traditional seeds are locally available and collected good seeds from the farmers own plots. Farmers either buy or exchange their seeds with other farmers. So the cost of seed is either minimal or nil. An outstanding feature of native seeds is diversity. They are hardy, developed resistance to the pests and diseases in that area. These also have high levels of tolerance to conditions of stress and are adapted to local agro-climatic conditions. The conservation of the seed is of paramount importance. Thus, organic farming preserves the traditional varieties/species.

Foods are often picked before they are ripe and allowed to ripen in transit, at the market or during home storage. The artificial ripening is also done by adding growth hormones and chemicals in large quantity which adversely affects the physiology of the food. They do not acquire their whole set of minerals and vitamins, which on natural course of ripening are present during the later stages of growth. Food products kept for longer duration as in transit or in market make them stale and deteriorate their nutritional statue of the food. Fruits and vegetables lose significant amounts of vitamin C with in three days in cold storage, and even more at room temperature. We can over come these problems if we grow or buy organically grown food.

2.3.2 Weaknesses

Despite of many large benefits about organic farming why do most farmers still operate by modern/conventional farming practices? In general, organic farming has certain weaknesses when compared with modern/conventional farming. Here, we tried to explore these issues from consumers and producers as well as from processors.

2.3.2.1 Productivity gaps

Yields on organic farms are generally lower than those on conventional or integrated farms. The magnitude of these yield differences varies considerably in the literature. A compilation of such data from five European countries is given in table 2.12.

Table 2.12 Average yields of organic crops (as % of conventional crops)

	Switzer-land	Austria	Germany	Italy	France
Wheat	64 – 75	62 – 67	58 – 63	78 – 98	44 – 55
Barley	65 – 84	58 – 70	62 – 68	55 – 94	70 – 80
Oats	73 – 94	56 – 75		88	
Grain Maize	85 – 88		70	55 – 93	66 – 80
Oilseeds	83	78 – 88	60 – 67	48 – 50	67 – 80
Potatoes	62 – 68	39 – 54	54 – 69	62 – 99	68 – 79
Pulses	88	83 – 85	49 – 73	73 – 100	83

Source: Niggli *et al*., 2008

The recent meta-study modeled from National surveys showed significantly smaller differences between organic and conventional yields from intensive farming in developed countries. Based on 160 field experiments, the average yields of all crops grown organically were only 9% lower than those grown conventionally. As most of the data came from trials conducted on research stations, the actual productivity gap may have been underestimated in this meta-study. On marginal soils and in less favourable climatic conditions, under permanent or temporary water stress and generally in subsistence agriculture, organic agriculture enhances food productivity. In many situations, the adaptation of state-of-the-art organic farming offers considerable potential for yield increase and yield stability.

2.3.2.2 Intensive in nature and high labor costs

It is true that converting to organic farming will not instantly solve all your problems as a farmer. However, there are very few farmers, who revert back to conventional farming after having converted to organic farming. Yet, the transition would be far easier in this direction (organic to conventional) than it was from conventional to organic because of conversion period requirements. This demonstrates that, overall, organic farmers are happy with their situation, that they can make a living from it, and that they find the advantages it brings more important than the disadvantages.

Organic farming also does not necessarily mean spending more time on farm. In the absence of mechanization (due to lack of research support from the mainstream system), several protocols of organic farming are indeed labour intensive. But this fact should go in favour of developing countries such as India where about 80% farmers are small-holder farmers and the government guarantees employment to its rural masses, for 100 days in a year. In due course, it should be possible to reduce the requirement of labour for several organic farming practices (Rupela, 2008).

2.3.2.3 Lack of established markets

Lack of established marketing channels or green markets are the major weaknesses in Indian organic food industry. Absence of or incomplete product information and certification procedures were also slowdown the growth of organic market in India. Improving the quality of products, packaging, logistic infrastructure and technical support to the producers and exporters are the need of the hour. More investments are required for improving the quality of research and development in the country. Government should apply and get for accreditation under different countries' national organic regulations. Participation and promotion of Indian organic products at international fairs (e.g. Bio-Fach) and creation of awareness to consumers will boost the sales of organic products globally as well as domestically.

2.3.2.4 Poor quality management in production and processing

While the government has taken measures to make organic products popular in the domestic market, the consumer is still waiting for the price to be on a par with other products. Prices are likely to come down when the farmer completes the conversion process and the output increases. As the demand goes up, other factors such as economies of scale will automatically set in, leading to a further drop in prices. Quality management in production and processing is an important step for organic market development. Success in the Indian organic market will be a dream without successful implementation of high quality standards. The quality management manuals are useless, unless they are prepared based on the work done in the field. The principles and standards of organic agriculture has to be known to all stakeholders, such as, farmers, processors, traders, exporters government etc. and the last but not the least to the consumers.

2.3.2.5 Less incentives from Government

Despite designating organic farming a major thrust area, India accounts for only $123 million in a $40 billion global organic food market. Promoting transparency and accountability, a traceability mechanism will build confidence internationally, particularly in Europe where nearly 70 per cent of our exports go. Countless small farmers are described as practicing organic farming "by default" because they can't afford to invest in chemical fertilizer-reliant agriculture. This isn't necessarily a bad thing if they can gain from it with greater access to training for skills upgrade, awareness about marketing opportunities and even absorption into big, scientifically run farms.

Conversion support scheme, 1987-1992

Denmark was the first country to introduce a financial support scheme for organic farming on a significant scale in 1987. The scheme covered the development of extension, information and marketing services as well as financial assistance during the conversion period, which led to a three-fold increase in size of the organic sector. The conversion support ranged between SK 750 and 2900 per ha per year for a maximum of three years, depending on land quality, yield potential and land use.

In Norway, a conversion support scheme was introduced in 1990. Each farm converting received a one-off payment of NK 15000 for farms less than 5 ha, and NK 20,000 for farms larger than 5 ha. The total budget allotted for this activity was NK 16 million including expenditure on advisory services and research.

In Australia, the conversion payments have resulted in a dramatic increase in the number of organic farms (from under 1500 in 1989 to an estimated 9000 in 1993) and the area of organically managed land (from 20,000 ha in 1989 to an estimated 135,000 ha in 1993 of nearly 3% of Australian agricultural land).

Source: Lampkin and Padel, 1994

With greater conversion support schemes, more and more players can benefit from the lower input costs as well as higher prices that organic farming represents compared to conventional farming. The farmers, on the other hand, are looking for a boost in the form of subsidies/financial support programs and a retail platform to showcase their products, which until now are picked up by co-operatives or NGOs.

2.3.2.6 Low R&D investments on organic farming research

Research and technological development conducted within functioning organic systems is essential to overcome some of the technical problems which still exists and to improve further increase in the potential of organic farming in the country. Current organic farming practices have been developed primarily by existing organic farmers against the background of scientific knowledge. So, significant public funding for research and development is crucial to boost organic farming sector further. There is also a need for introduction of special courses on organic farming and increase in number of training programs, particularly in state agricultural universities which will boost the trust and awareness in farmers. The outcomes of these research and experiments would also help to overcome the apprehensions about organic farming in the country.

2.3.2.7 Organic market buyers/consumers driven market

Besides the producer-driven approach to organic agriculture, a market-driven approach in developing countries has developed in parallel. The growing demand for organic products in industrialized countries, particularly, the EU, United States and Japan, has lead to a growing international trade over the past 15 years. The typical character of Indian organic food market is buyers/consumers driven rather than producers/supply driven. This is because of low awareness about organic food and its benefits when compared to conventional food. The percentage of population who has affordability to buy organic food is also low. But, it is taking up well in the recent times with increase in health awareness. The producers/suppliers have no upper hand in the market. However, they have to create more awareness among population and market their products. Ultimately, the choice lies with consumers/buyers only.

2.3.2.8 Lack of strategy for development of organic market

The Indian organic market is a typical example for a market in the pre-growth-phase. In this phase, there is already some awareness about food quality and pesticides residues among consumers. This is advantageous for the fast growth of the organic market. But, there is also a danger that the awareness is not based on the true values of organic agriculture. Surprisingly different meanings for the word “organic” are exists in the India. The expression “organic” is still not protected and the awareness is diffused. It will be a difficult task to find the right approach to transform this improper awareness in the correct way among consumers. So, the first important strategy at the beginning itself to define what are organic products, how are they different from conventional products. It will help in describing the USP (Unique Selling Position) of organic products in the market. This is the reason why awareness has to be created at the beginning. Positioning and credibility of the organic products for the future are second important strategy for the organic market development. Without consumers trust, organic farming is lost. Quality management is the third important strategy for building up of an organic market. There will be no success in Indian organic market without quality assurance on a high level.

2.3.2.9 Disjointed producers, processors and traders

Mainstreaming of organic foods has serious implications for the governance of domestic and international supply networks. Collaboration between trade partners has become increasingly important for the successes of any business sector. Basically, Indian organic market is characterized by disjointed producers, processors and traders. In countries like India, small scale producers play a crucial role in expanding organic export sector due to organic farming being labor intensive in nature and its compatibility with traditional peasant practices. Connecting these small and marginal producers with organic export networks/chains is need of the hour. Development of organic supply chains is viable solution to achieve this collaboration. They refer to networking different actors being linked from farm to fork to achieve more effective and market oriented flow of goods. Improvement of these chains needs good knowledge to develop a workable structure and assurance of its sustainability. Partnership and integration are the key factors of success for supply chains (Singh, 2009).

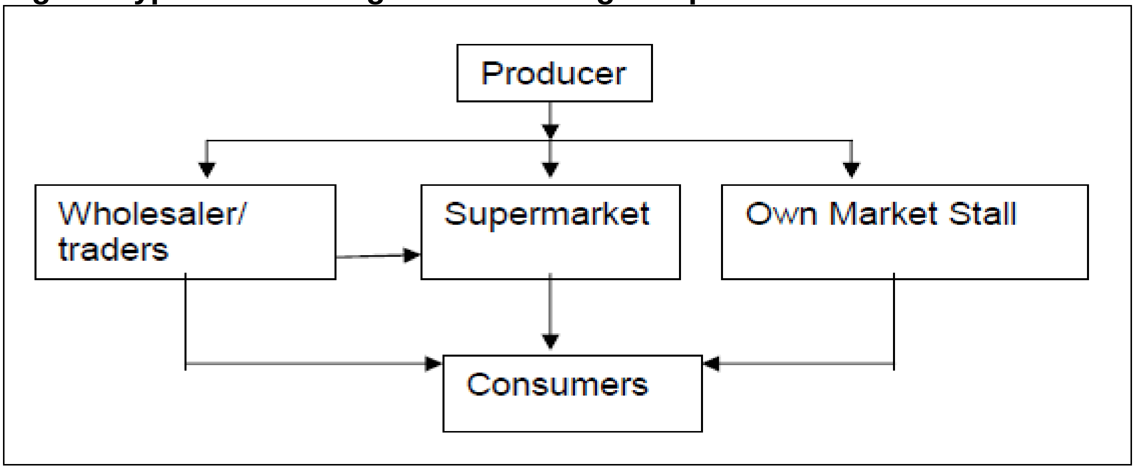
2.3.2.10 Adulteration and poor quality of organic inputs

Absence of recognized/established organic input marketing channels led to the problems of poor quality and adulteration of organic inputs in India. Conventional/modern input dealers and retailers are not showing interest to deal with organic inputs marketing because of low demand and lack of distribution network. The erratic supplies of organic inputs and low levels of awareness of cultivators also added to this situation (Narayanan, 2005). However, recently government has formulated product standards and specification for vermi-compost, city-compost and for bio-fertilizers. But, improper inspection and regulation makes these problems on nascent organic farming in the country. Application of poor and adulterated organic inputs looses the confidence of the farmers on organic farming due to their poor performance. There is a need for government to initiate the establishment of organic input marketing channels in the country (Ghosh, 2004). These channels not only build the confidence in farmers but also assure timely availability at reasonable prices. An emergency action for regulation is needed especially for marketing of bio-fertilizers and bio-pesticides for which the awareness among farmers is very low.

2.3.2.11 Large number of small farms with weak organizational building

The domestic market for organic products is not yet developed as the export market. The products available in the domestic organic market are rice, wheat, tea, coffee, pulses, fruits and vegetables. Wholesalers / traders and supermarkets play major roles in the distribution of organic products. As most organic production originates from small farmers, wholesalers / traders account for a 60% share in the distribution of organic products (see fig 2.6). Large organized producers distribute their products through supermarkets as well as through self-owned stalls. Considering the profile of existing consumers of organic products, supermarkets and restaurants are the major marketing channels for organic products. While certification is mandatory for exports, products for domestic consumption are mostly uncertified. This is because most producers are either small or marginal farmers, small cooperatives or trade fair companies. The small farmers, scattered across the country, offer an incomplete product range that are mostly available as a small or local brand. In contrast, in countries like the US and Europe, every supermarket houses a complete range of certified organic products. Therefore, the need of the hour is organized retailing and marketing from the prevalent unorganized pattern (Singh, 2009)

Fig 2.6 Typical marketing channel of organic products in India



2.3.3 Opportunities

Organic farming has several opportunities right from growing domestic market to earn high foreign exchange through agricultural exports. Countries like India have strong comparative and seasonal advantages in organic food production. The huge untapped potentialities are briefed below:

2.3.3.1 Big and growing market potential

Organic food products are slowly but steadily finding their way in the average Indian household. As an upcoming segment in retail, it is indicative of the rising health-consciousness among the Indian consumers. Pegged at Rs. 5.6 billion in 2008, the organic food market is gradually witnessing the shift from being an elitist to a healthy product. Although production and consumption figures in India are way behind the world average, the market is now showing signs of consistent growth. As of now, price continues to be the major deterrent. It is gradually being outweighed by factors such as nutrition, taste, quality and better environment. The market for organic food products has largely been characterized by inadequate retail presence, absence of certified brands, incomplete range, higher price and highly export-oriented government policies. Notwithstanding these shortfalls, retailers are optimistic about the future, as awareness about the benefits of organic food is slowly picking up. India may well take a long time to catch up with the global growth rate of 20-30% annually.

Recently International Competence Centre for Organic Agriculture (ICCOA) conducted a survey in top 8 metro cities of India (which comprise about 5.3 % of the households) to assess the organic food market potential and consumer's inclination and behavior towards organic food (table 2.13). The market study estimated that the accessible market potential for organic foods in 2006 in top 8 metros of the country at Rs 562 crores taking into account current purchase (2005-06 prices and considering organic premium 10-20%) patterns of consumer in modern retail format. The overall market potential is estimated to be around Rs.1452 crores, the availability will however be a function of distribution-retail penetration and making the product available to the customer. Another finding of the survey was consumer's preference for different categories of organic food. Across all cities and regions, the most preferred category is the fresh vegetables followed by fruits, milk and diary products.

Table 2.13 Market potential for organic foods

STUDY PRODUCTS	Accessible Potential		Market Potential	
	Rs Million	%	Rs Million	%
Vegetables	1030	18	3220	22
Fruits	710	13	2460	17
Milk	520	9	1660	11
Dairy product	500	9	1110	8
Bakery Products	480	9	1860	13
Oils	320	6	590	4
Rice	270	5	460	3
Ready to eat	260	5	360	2
Wheat -Atta	250	5	4700	3
Snacks	220	4	560	4
Frozen foods	220	4	300	2
Dals	180	3	320	2
Health Drinks	170	3	340	2
Canned foods	170	3	230	2
Tea	120	2	230	2
Coffee	100	2	170	1
Condiments	50	1	120	1
Spices	40	1	80	1
Sugar	2.8	0	4.8	0
Baby Food	0.1	0	0.30	0
TOTAL	5620	100	14520	100

Source: Rao *et al*, 2006

2.3.3.2 Growing purchasing power of consumers

India's Gross Domestic Product (GDP) expanded 7.90% over the last 4 quarters. India's GDP worth 1217 billion dollars or 1.96% of the world economy, according to the World Bank. India's diverse economy encompasses traditional village farming, modern agriculture, handicrafts, a wide range of modern industries, and a multitude of services. Services are the major source of economic growth, accounting for more than half of India's output with less than one third of its labor force. The economy has posted an average growth rate of more than 7% in the decade since 1997, reducing poverty by about 10 percentage points. The GDP per capita (Purchasing power parity) of the country is presented in fig 2.7 between 2000 and 2008. It registered a growth of 95 per cent with in span of eight years. This high purchasing power will boost the domestic retail markets including organic foods. Growing health awareness coupled with increasing per capita incomes enhances the affordability towards organic food. (Source: ***www.tradingeconomics.com***)

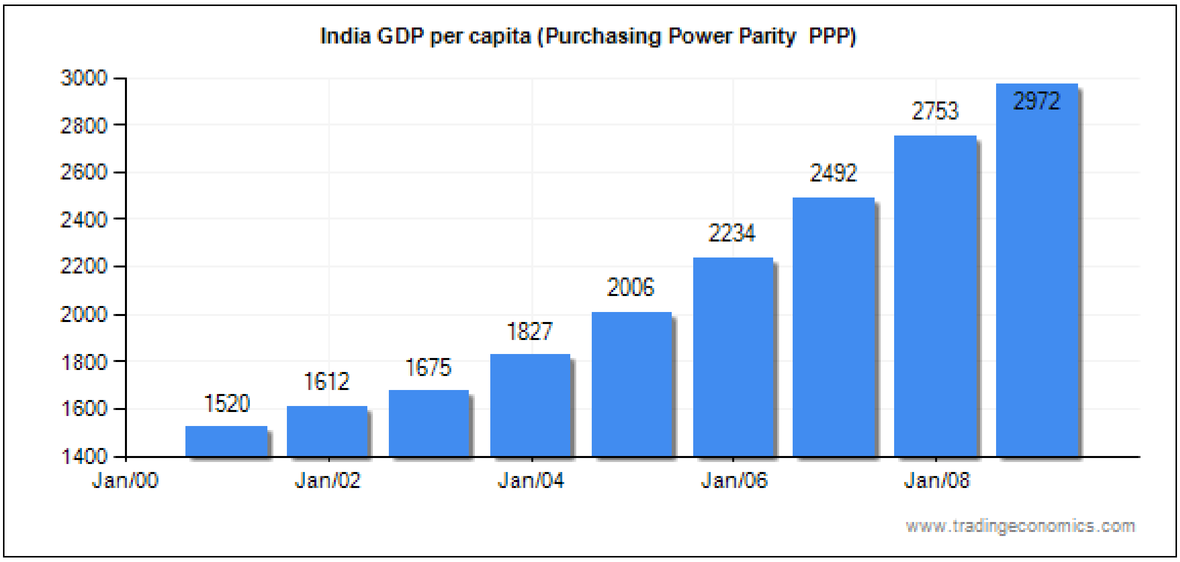


Fig 2.7 India GDP per capita purchasing power parity

2.3.3.3 70% of GCA is under rain fed agriculture

Majority of rain fed farmers in remote areas still practice low external input or no external input farming which is well integrated with livestock, particularly small ruminants. The average use of chemical fertilizers in rain fed areas based on a survey of non irrigated SAT districts was found to be 18.5 kg as against 58 kg in the irrigated districts (Katyal and Reddy, 1997). Based on several surveys and reports, it is estimated that upto 30% of the rain fed farmers in many remote areas of the country do not use chemical fertilizers and pesticides. Thus, many resource poor farmers are practicing organic farming by default. The Government of India task force on organic farming (2001) and several other reviewers have identified rain fed areas and regions in north east are more suitable for organic farming in view of the low input use (GOI, 2001; Dwivedi 2005; Ramesh *et al* 2005).

While rain fed regions undoubtedly offer good scope for organic production at least in niche areas and commodities (table 2.14), a number of research, development and policy issues need to be addressed before realizing the potential. They are: development of protocols for organic production of important commodities through farmers participatory network research, create awareness, capacity building of different stakeholders on different aspects of organic production and development of preferential policy instruments for rain fed farmers particularly in terms of providing market information, subsidized supply of inputs and group certification etc. (Venkateswarlu, 2005).

Table 2.14 Commodity wise potential for organic production in rain fed regions

Commodity	**Scope/Opportunity**	**Potential Area**
Cotton	Demand for organically produced lint. To cut down on chemical use	Maharashtra, A.P., Karnataka, Gujarat
Sesame	Demand for organic sesame seed for medicinal and confectionary uses	Gujarat, Rajasthan
Niger	Demand for niger seeds produced organically for bird feed in Europe	Tribal areas of different states, in particular Orissa and Chhattisgarh
Lentil	Preference for Indian lentil in world markets; organic product to fetch price premium	U.P.
Safflower	Growing market for safflower petals as natural food dye and herbal products	Maharashtra
Finger millet	Scope to export fingermillet flour as health food ingredient	Karnataka, Orissa, Jharkhand
Medicinal herbs	Need for residue free crude drugs	All over India
Ginger/Turmeric	Demand for residue free spices/natural colours	Orissa
Groundnut	To produce residue/toxin free table varieties	Gujarat
Soybean	Demand for organically produced DOC for livestock feed	M.P.

2.3.3.4 Growing health awareness

Organic products, which until now, were mainly being exported, are now finding more consumers in the domestic market. The nutritional benefits of these products have ushered in the organic food revolution in the country, which is currently at a nascent stage. Although health is the key reason for growing demand, other incidental benefits such as better taste and better environment are also driving growth. There is growing awareness of the environment and the dangers of chemically grown products. Besides, with a growing number of retailers offering various organic products, they are now more visible and therefore, are more likely to generate demand. Another key factor driving demand has been the change in the consumer perception from organic products being elitist to healthy. The rising health-consciousness will certainly trigger demand in the near future.

2.3.3.5 Reduce heavy subsidies on food and fertilizers

Food grain production in India has almost hit a plateau in recent years. In any case the production is not commensurate with the increased use of high cost inputs like seeds of hybrid/improved varieties, fertilizers and plant protection chemicals. Agriculture production has tended to remain either stagnant or is declining despite application of high cost inputs in large number of agricultural zones. Agriculture production despite troughs due to drought and aberrant weather conditions showed remarkable resilience but the quantum jump in production is conspicuous by its absence. Experts attribute this stagnation to destruction of soil health due to application of fertilizers and pesticides. However, estimates of fertilizer subsidy as per central government budgets over the years in the post-reforms era show that it has increased significantly. Table 2.15 presents the estimates of major subsidies including the food and fertilizer subsidies in the post-reforms period (1991-92 to 2008-09). It is evident form the table that total subsidies have increased from Rs. 12158 crore in 1990-91 to Rs. 129243 crore in 2008-09, an increase by 10.6 times. The fertilizer subsidy has increased from Rs. 4389 crore in 1990-91 to Rs. 75,849 crore in 2008-09 representing an increase of over 17 times. As a percentage of GDP, this represents an increase from 0.85 percent in 1990-91 to 1.52 percent in 2008-09 (Sharma and Hrima, 2009).

India can with drawl this high burden of fertilizer subsidies by transforming major cropped area to organic farming in systematic manner (Ghosh, 2004). It not only saves our economy but also provides safety and sustainability to our soils and environment. Government should develop a strategic plan for the phased conservation of conventional/modern system to organic agriculture. An investment of the same amount for encouraging the organic inputs use and on organic agricultural research will propel our agricultural exports/ export earnings.

Table 2.15 Food and fertilizer subsidies in India, 1990-91 to 2008-09 (Crores)

Year	Food	Fertilizers				Total Subsidies
		Indigenous Urea	*Imported Urea*	*decontrolled fertilizers*	*Total*	
1990-91	2450	3730	659	-	4389	12158
1991-92	2850	3500	1300	-	5185[2]	12253
1992-93	2800	4800	996	-	5796	11995
1993-94	5537	3800	762	-	4562	11605
1994-95	5100	4075	1166	528	5769	11854
1995-96	5377	4300	1935	500	6735	12666
1996-97	6066	4743	1163	1672	7578	15499
1997-98	7900	6600	722	2596	9918	18540
1998-99	9100	7473	333	3790	11596	23593
1999-00	9434	8670	74	4500	13244	24487
2000-01	12060	9480	1	4319	13800	26838
2001-02	17499	8044	47	4504	12595	31210
2002-03	24176	7790	-	3225	11015	43533
2003-04	25181	8521	-	3326	11847	44323
2004-05	25798	10243	494	5142	15879	45957
2005-06	23077	10653	1211	6596	18460	47522
2006-07	24014	12650	3274	10298	26222	57125
2007-08	31328	12950	6606	12934	32490	70926
2008-09 (RE)	43627	16517	10981	48351	75849	129243

Source: Sharma and Hrima (2009)

2.3.3.6 Control the nitrate leaching and CO_2 emissions

The nitrate leaching was lower in organic farming compared to the modern/conventional farming. The results of the studies on nitrate leaching conducted in Germany and the Netherlands were summarized in table 2.16. It shows that under Western European conditions nitrate leaching rates per hectare are significantly lower in organic agriculture. Organic farming rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes and biological pest control to maintain soil productivity and tilth.

Table 2.16 Nitrate leaching rates per hectare

Reduction of nitrate leaching rates in Organic farms compared to conventional farms	Authors
> 50 per cent	Smilde (1989)
> 50 per cent	Vereijken (1990)
57 per cent	Paffrath (1993)
50 per cent	Reitmayr (1995)
40 per cent	Berg *et al* (1997)
64 per cent	Haas (1997)

Source: Stolze et al., 2000

Agriculture is an undervalued and underestimated climate change tool that could be one of the most powerful strategies in the fight against global warming. Nearly 30 years of Rodale Institute soil carbon data shows conclusively that improved global terrestrial stewardship specifically including regenerative organic agricultural practices can be the most effective currently available strategy for mitigating CO_2 emissions. Rodale Institute's Farming Systems Trial (FST) is the longest-running side-by-side comparison of organic and conventional farming systems in the U.S.A and one of the oldest trials in the world. It has documented the benefits of an integrated systems approach to farming using regenerative organic practices. These include cover crops, composting and crop rotation to reduce atmospheric carbon dioxide by pulling it from the air and storing it in the soil as carbon. Results from these practices corroborated at other research centers that include University of California at Davis, University of Illinois, Iowa State University and USDA Beltsville, Maryland, research facility reiterate the vast untapped potential of organic agricultural practices to solve global warming.

In general, conventional/modern farming practices break down soil carbon into carbon dioxide that is released into the atmosphere, greatly contributing to global warming. Surprising analysis of the US oldest continuous cropping test plots in Illinois showed that, contrary to long-held beliefs, nitrogen fertilization does not build up soil organic matter. New data from U.S. government research shows that with agriculture using chemical fertilizers and herbicides, the U.S. food system contributes nearly 20 percent of the nation's carbon dioxide emissions. On a global scale, figures from the Intergovernmental Panel on Climate Change (IPCC) say that agricultural land use contributes 12 per cent of global greenhouse gas emissions. Organically managed soils can convert carbon from a greenhouse gas into a food-producing asset. Soils that are rich in carbon conserve water and support healthier plants that are more resistant to drought stress, pests and diseases. The study conducted by Lasalle and Hepperly (2008) on organic systems have shown an increase of almost 30 percent in-soil carbon over 27 years.

2.3.3.7 Earn high export earnings

Currently almost 90 organic products in 15 different categories are exported from India. According to estimates given by APEDA, the organic sales in 2008 have increased to 100 million US $ from 25 million US $ in 2005. By 2012 the market is expected to grow six to seven times faster than previously and reach the billion-mark, according to the ambitious planning by the National Centre for Organic Farming (NCOF), which is part of the Ministry of Agriculture. The most important export goods include organic cotton, currently accounting for a 25 %-share of sales, followed by tea (20 %), dry fruits (18 %), basmati rice (13 %) and honey (10 %).

India is emerging as the top organic cotton-producing country, Oct 1st, 2009

Dr Selvam Daniel, Managing Director, ECOCERT India, an affiliate of the eponymous French global certification MNC, has said that Indian textile companies would corner a sizeable share in the global organic textile industry with India emerging as the top organic cotton-producing country. “The area under cotton cultivation increased to 161,000 hectares in top organic cotton-producing countries like Syria, India, Turkey and China.” In 2007-08, global organic cotton production increased by 152 per cent. In India, Cotton is the single largest crop under organic management with an output of approximately 142,714 MT during the year 2006-07. Cotton is being grown mainly in Madhya Pradesh, Maharashtra, Orissa and Andhra Pradesh. With an estimated production of more than 1.42 lakh tons of organic cotton, India has probably achieved the status of largest organic cotton grower in the world replacing Turkey. Majority of the cotton so produced is processed in India and is being exported only as textile. As per International norms the textiles can not be labeled as organic. All such textiles are sold/ exported under the brand “Made from certified organic cotton”. (Source: www.iccoa.org)

2.3.4 Threats

There are few threats for the growth of organic farming in India as well. Until and unless we solve these issues/problems, the expansion of organic farming is in question. The major concerns are:

2.3.4.1 High cost of organic food

High costs per unit of organic foods than the conventional food put the consumers on the back track in India. But, the overall cost to society of producing food organically is actually lower than the cost of conventional production. The price of conventional food is artificially lowered by production-oriented subsidies. Negative externalities caused by conventional farming are not accounted for the price of food (Pretty, 2005). Pretty in his another study in 2000 calculated that the total hidden or 'external' cost of non-organic farming in the UK to the environment and to human health was £2.34 billion per year (based on 1996 data) or £208 per hectare. Organic farming has, by contrast, only one third of the hidden costs of non-organic agriculture, and would reduce the external costs of agriculture by £1.6 billion or to £120 - £140 per hectare. Actually, organic agriculture is still facing unfair competition in the marketplace due to the competition distorting effect of current subsidy schemes. In Northern countries, the organic premium is declining due to increasing economies of scale in processing and commercialization of organic products as the sector develops. Nevertheless, it is likely that a premium will remain due to additional certification costs, higher consumer demand, and more demanding production standards. In developing countries, uncertified organic food is generally cheaper to produce and sold at the same price as conventional food. In some cases, the price difference is the result of the specific willingness of consumers to pay higher prices and does not reflect a higher cost of production.

2.3.4.2 Costly and complex organic certification process

Most certifiers are charging inspection and certification fees based on the number of person days involved, plus fees for the issue of certificates. Sometimes, different fees are applied for small farmers, large farmers, and processors or traders. An example of the fee structure of a certification body operating in India is given in table 2.17. Over the past few years, many international certifiers opened branch offices in India. The cost of certification is coming down but still it is very high for small holders group and individual farmers. With the local certification bodies started to emerge, the costs will soon reach lowest possible level while ensuring quality. Cost, quality of certification, lengthy procedures, ability of services, international validity and complicate in nature are constraints faced by the farmers. So while pursuing export-friendly strategies, the authorities must think of innovative ways to ease the certification process. Making universally recognized accreditation simpler and cheaper for small organic farmers to acquire is the first step to increasing their formal participation in the sector.

Table 2.17 Annual expenses for inspection and certification (Eg: Ecocert)

Type	NPOP + International Certifications (EC, NOP or JAS)
1. Inspection and reporting	
1.1 Small Holder Groups	Rs. 16,000 per day
1.2 Estates	Rs. 16,000 per day
1.3 Individual Farmers	Rs. 8000
1.4 Small Processors	Rs. 16,000 per day
1.5 Medium Size Processors	Rs. 16,000 per day
1.6 Manufacturers/exporters/ importers	Rs. 17,000 per day
2. Certification	
2.1 Small Holder Groups	Rs. 15,000 per day
2.2 Estates	Rs. 15,000 per day
2.3 Individual Farmers	Rs. 15,000 per day
2.4 Small Processors	Rs. 15,000 per day
2.5 Medium Size Processors	Rs. 15,000 per day
2.6 Manufacturers/exporters/Importers	Rs. 15,000 per day

Source: APEDA, 2010

2.3.4.3 Lack of infrastructure facilities and certification bodies

The organic supply chain currently suffers lack of infrastructure and high costs linked to handling small quantities for growing niche markets. The greater diversity of enterprises in organic production means that economies of scale are less easily achieved. Post-harvest handling of relatively small quantities of organic foods results in higher costs, especially given the mandatory segregation of organic and conventional produce, particularly for processing and transportation. Marketing and the distribution chain for organic products are relatively inefficient and costs are higher because of the relatively small volume. As demand for organic food and products increases and the sector get developed in infrastructure, technological innovations and economies of scale are likely to reduce costs of production, processing, distribution, and marketing for organic produce. This phenomenon is already perceived by consumers in the main organic markets such as Germany and the US, where some organic products are now being sold through usual marketing channels. Till 2010, there were only 18 accredited certification bodies in the country (table 2.18). The number of bodies is growing up slowly which are in-adequate. Many state government agencies are in the queue and are getting ready for obtaining accreditation. But, the recognized green markets are very few; the trade channels are yet to be formed in the country.

Table 2.18 List of accredited certification bodies under NPOP

Sr. No	Name of the Certification Agency	Contact Person & Address	Scope of Accreditation
1	Bureau Veritas Certification India Pvt. Ltd.,	Mumbai, Maharashtra	NPOP, USDA, NOP
2	ECOCERT India Pvt. Ltd.,	Aurangabad, Maharashtra	NPOP, USDA, NOP
3	IMO Control Pvt. Ltd.	Bangalore	NPOP, USDA, NOP
4	Indian Organic Certification Agency (INDOCERT)	Cochin, Kerala	NPOP, USDA, NOP
5	Lacon Quality Certification Pvt. Ltd.,	Thiruvalla, Kerala	NPOP, USDA, NOP
6	Natural Organic Certification Agency (NOCA)	Pune	NPOP, USDA, NOP
7	OneCert Asia Agri Certification Pvt. Ltd.	Jaipur, Rajasthan	NPOP, USDA, NOP
8	SGS India Pvt. Ltd.	Gurgaon, Haryana	NPOP, USDA, NOP
9	Control Union Certifications	Mumbai, Maharasthra	NPOP, USDA, NOP
10	Uttarakhand State Organic Certification Agency (USOCA)	Dehradun, Uttarakhand	NPOP, USDA, NOP
11	APOF Organic Certification Agency (AOCA)	Bangalore, Karnataka	NPOP
12	Rajasthan Organic Certification Agency (ROCA)	Jaipur, Rajasthan	NPOP
13	Vedic Organic Certification Agency	Hyderabad, A.P	NPOP
14	ISCOP (Indian Society for Certification of Organic Products)	Coimbatore, Tamil Nadu	NPOP
15	Food Cert India Pvt. Ltd	Hyderabad, A.P	NPOP
16	Aditi Organic Certifications Pvt. Ltd	Bangalore	NPOP
17	Chhattisgarh Certification Society, India (CGCERT)	Raipur, Chhattisgarh	NPOP
18	Tamil Nadu Organic Certification Department (TNOCD)	Coimbatore, Tamil Nadu	NPOP

Source: APEDA, 2010

2.3.4.4 Only export regulated organic market

Various countries in Europe, Latin America and Asia including Japan were introduced organic legislation in the 1990s. In 1999, the Codex Alimentarius approved the first guidelines for organic plant production, which were amended to include livestock production in 2001. In the new millennium, most major economies have established a regulation for organic production, including the Indian National

Programme for Organic Production (NPOP), which passed in 2001, the US National Organic Program (NOP) that came into force in 2002, the Chinese legal framework, which was finalized in 2005 and the Canadian legislation that passed at the end of 2006. According to the FiBL Survey, 2008; only 60 per cent of the countries in the World have submitted their regulations whether they are implemented fully or partially. Remaining 40 per cent of non-responding countries did not pass the regulation in their country so far. However, in India the regulation was implemented through National Project on Organic Production (NPOP). So far regulation in India was limited to only export organic products but not in domestic market.

2.3.4.5 Low awareness about organic inputs

Many farmers in the country like India have only vague ideas about organic farming and its advantages as against the conventional farming methods. Farmers lack knowledge of compost making using the modern techniques and also its application. Use of bio-fertilizers and bio-pesticides requires awareness and willingness on the part of the farming community. Government should conduct more conferences, seminars, and farmers' fairs to raise awareness and encourage adoption of organic farming in the country. Programs demonstrating how to establish organic systems, and training in how to produce and manage organic inputs, should be started at the village level. Under the NPOF, sufficient provision has been made to train farmers for organic production and internal control and to develop both model organic farms and a nationwide network of organic service providers (to provide guidance, establish farmers' groups and arrange organic inputs). There is also a need for establishment of organic input channels for better marketing and timely availability.

2.3.4.6 Most of the fields are contiguous and problem of contamination

Most of the farmers in India are belong to small and marginal category. Most of their fields are in small pieces and contiguous in nature. They lack fixed/strong field boundaries and irrigation channels. It is very difficult for small and marginal farmers to adopt organic techniques because of the problem of contamination. Most of their fields are also not covered by any wind breaks/bio-fence. This lead to contamination of fertilizers applied at one farmer plot to neighbour farmer’s plot through irrigation water. Sometimes, the application of pesticides or herbicides will also contaminate the adjoining farmer plot because of wind. These types of problems can only be solved by group adoption of organic technology. The group adoption will also help the farmers in better management of outbreak of new pests and diseases in that area.

2.3.4.7 Introduction of GM crops

Genetic engineering is creating new forms of pollution identified as genetic pollution. Across the World evidences are emerging about the reality of threat from this new form of pollution. The nature of genetic pollution is different from that of chemical pollution in the sense that there is no abatement for this type of pollution. The risks associated with genetic pollution arise from a number of aspects of genetic engineering. The transgenic organisms are modified organisms with a foreign gene which behave differently in the ecosystem. The ecological impacts of such organisms are a function of the explicit properties of the added genes, the effects of new combinations of genes and specific environmental situations. Transgenic organisms also carry risks because exotic genes are also introduced through the use of viruses and plasmids as vectors, which themselves can create ecological risks. Transgenic crops contain antibiotic resistance markers that carry the risks of antibiotic resistance spreading. The summary of different field performances of transgenic crops is presented in table 2.19.

Table 2.19 Field performance of transgenic crops

Transgenic Crop Released	*Performance*	*Reference*
1. Bt transgenic cotton	Additional insecticide sprays needed due to Bt cotton failing to control bollworms in 20,000 acres in eastern Texas	The Gene Exchange, 1996; Kaiser, 1996
2. Cotton inserted with Roundup Readgô gene	Bolls deformed and falling off in 4-5 thousand acres in Mississippi Delta	Lappe and Bailey, 1997; Myerson, 1997
3. Bt corn	27% yield reduction and lower Cu foliar levels in Beltsville trial	Hornick, 1997
4. Herbicide resistant oilseed rape	Pollen escaped and fertilised botanically related plants 2.5 km away in Scotland	Scottish Crop Research Institute, 1996
5. Virus resistant squash	Vertical resistance to two viruses and not to others transmitted by aphids	Rissler, J. (Personal communication)
6. Early FLAVR-SAVR tomato varieties	Did not exhibit acceptable yields and disease resistance performance	Biotech Reporter, 1996
7. Roundup Ready Canola	Pulled off the market due to contamination with a gene that does not have regulatory approval	Rance, 1997
8. Bt potatoes	Aphids sequestered the Bt toxin apparently affecting coccinellid predators in negative ways	Birch et al., 1997
9. Herbicide tolerant crops	Development of resistance by annual ryegrass to Roundup	Gill, 1995

Source: Shiva et *al*., 2000

2.4 Underlying issues and Conceptual framework

Conversion from inorganic to organic farming takes a while for the soil to adjust to both biological and chemical change processes. Due to this, farmer may face initial year's lower yields when compared to modern farming. There is a time lag for attaining competitive yields in organic farming. But, in case of modern farming, the results are input responsive and spontaneous. Farmers' are getting lured to modern farming techniques without bothering about the long run environmental consequences and sustainability issues (box 1).

> Box 1: Yield increases resulting from the so-called "Green Revolution" have slowed and are currently linked to soil degradation (Kaiser, 2004), which is considered a threat to food supply stability. Pimentel, et al. (2005) calculated a loss of nearly a third of the world's arable land to erosion within the last 40 years with an on-going loss of more than 10 million ha per year. Bellamy, et al. (2005) found massive losses of carbon in soils across England between 1978 and 2003. Their estimates ranged from 0.5 to 2 g soil carbon per kg soil per year with all but 8 percent of the investigated cropland affected by erosion – a factor the authors identified as the main reason for losses in soil carbon and therefore in soil fertility.

It is a choice between the short term and long term interests of farmers. The long run external environmental costs are much lower in organic farming than that of modern agriculture. In some areas; organic farming has capacity to even reverse the problems of land degradation (box 2).

> Box 2: Reganold, et al. (1987), in comparing soils from organic and conventional farms in Washington, USA, found organic fields had top soils 16 cm deeper and a higher organic matter content which resulted in soils less prone to erosion. A long-term Swiss field experiment on loess soil that began in 1978 (Mäder, et al., 2002) found the aggregate and percolation stability of both bio-dynamic and organic plots were significantly higher (10 to 60 percent) than conventionally farmed plots. This also affected the water retention potential of these soils in a positive way and reduced their susceptibility to erosion. Soil aggregate stability was strongly correlated to earthworm and microbial biomass, important indicators of soil fertility (Mäder, et al., 2002). The long-term application of organic manure positively influenced soil fertility at the biological, chemical and physical level, whereas the repeated spraying of pesticides appeared to have negative effects. Compared to stockless conventional farming (mineral fertilizers, herbicides and pesticides), repeated measurements of aggregate stability in plots with livestock-based integrated production (mineral and organic fertilizers, herbicides and pesticides) found 29.4 percent higher values while in organic and bio-dynamic plots (organic fertilizers only), it was 70 percent higher (Siegrist, et al., 1998). The Swiss long-term study underlines the importance of using manure, by means of organic agriculture, as a good practice for soil quality preservation (Fließbach, et al. 2007).

Some times, it also leads to a conflict between individual and group approach towards organic farming. All the farmers who are having contiguous fields should be encouraged to follow organic methods to avoid problems related to leaching or contamination of chemical fertilizers and pesticides. Increased food production in the developing countries like India through conversion of subsistence systems to organic management is more a serious proposition. The challenge is neither agronomic nor economic but socio-political. Well managed organic agriculture uses a number of preventive approaches that can greatly reduce the risk of severe yield fluctuations due to climatic and other uncontrolled incidents, contributing to the resilience of the food supply. Due to its agro-ecological approach, organic agriculture is an effective means to restore environmental degradation and improve soil fertility.

Organic producer farmers anticipate premium prices for their products when compared to that of modern agricultural outputs due to their quality and rich nutritional value of produce. But initial lower yields coupled with marginal premium prices in organic farming, farmers did not get convinced by this system. They are still fascinated about modern farming ignoring long run sustainable benefits of organic farming (box 3).

Box 3: K G Shirsagar (2008) studied the impact of organic farming on economics of sugarcane cultivation in Maharashtra. The study is based on primary data collected from two districts covering 142 farmers, 72 growing Organic Sugarcane (OS) and 70 growing Inorganic Sugarcane (IS) in Maharashtra. The study finds that OS cultivation enhances human labour employment by 16.90 per cent and its cost of cultivation is also lower by 14.24 per cent than IS farming. Although the yield from OS is 6.79 per cent lower than the conventional crop, it is more than compensated by the price premium received and yield stability observed on OS farms. The OS farming gives 15.63 per cent higher and more stable profits on OS farms than the IS farms. The OS farmers also reported that the period involved in conversion from conventional farming to organic farming is the most critical one. The study also showed that it takes at least three years to complete the conversion from inorganic to organic successfully. If feasible, the beginners should shift to organic farming in stages rather than trying to convert all the landholding at once.

To promote sustainable agriculture in the country, government should encourage the organic growers by providing some incentives to them. They also should get support by linking them with domestic as well as export markets and by providing minimum support prices to their products. The process of organic certification should be made simpler so as to reach many small and marginal farmers in the country.

2.5 Government Policies for development of organic farming in India

Brief history

Traditional agriculture in India dates back to the Neolithic age of 7,500-6,500 BC. The farmers of ancient India are known to have evolved nature friendly farming systems and practices such as mixed farming, mixed cropping and crop rotation. The balance of cosmic forces, health and fertility were the main characteristics. Hindu philosophy regards the earth as a living being. She is considered the source of all plants, especially crops, and when cultivated or explored, provides all necessities of life not only for human beings, but also for all other forms of life, right from the smallest living cell to the largest animals. Farmers' knowledge of plant life was highly advanced.

The first "scientific" approach to organic farming can be quoted back to the Vedas of the "Later Vedic Period", 1,000 BC to 600 BC (Randhawa 1986 and Pereira 1993). The essence is to live in partnership with, rather than exploit, nature. The "Vrkshayurveda" (Science of plants), the "Krshisastra" (Science of agriculture) and the "Mrgayurveda" (Animal Science) are the main works, (Mahale and Sorée 1999). Here agriculture was not developed just as a production system, but as a culture. Great attention was paid to agricultural technologies and agronomic practices and sophistication was achieved through genetic diversity, crop rotation and mixed cropping systems. Animal husbandry was an integral part of the farming practice.

Classical Indian plant science, Vrikshayurveda in the form of Sanskrit hymns, is a corpus of rich textual knowledge. It encompasses areas such as the collection, selection and storage of seeds, germination, sowing, various techniques of plant propagation, grafting, nursing and irrigation, testing and classification of soil and selection of soil suitable to various plants/types of plants, manuring, pest and disease management/ preventive and promotive care to build up disease resistance and to cultivate healthy plants. Favourable and unfavourable meteorological conditions were taken care off. Plants were used as indicators of weather, water, minerals etc. This knowledge system is even today present with millions of Indian farmers as its practitioners. Furthermore, it is propagated in many forms, such as folk songs, rituals, proverbs and riddles. Organic agriculture practices make use of these indigenous knowledge systems and try to integrate them in the modern organic agricultural practices, thus making changes easier and more effective.

Historical evidence indicates high yields in India comparable to today's highest levels which was a result of the careful husbanding of soil and well adapted seeds and crop varieties. India once had 30,000 varieties of rice. These varieties were not used at random, but were delicately fitted into their appropriate ecological niches. In the vision of this tradition, there is no distinction between the sacred and the profane: everything is sacred. Farmers paid a great deal of attention to agriculture, livestock, rain harvest and the art of composting. The wisdom gained and practices adopted by these farmers were passed down through generations and became ingrained in the cultural outlook of the society. Even today the belief system, the myths, rituals and religious festivals of the Indians encompass these principles of soil, plant and animal health.

In the past five decades, the traditional knowledge and organic principles were eroded because of the influx of modern conventional agriculture. However, this knowledge has been sustained by many Indian communities throughout the millennia and has gained renewed importance recently for present agriculture, especially organic agriculture. Organic farming practices still are a part of the living tradition of most of the Indian communities in the tribal and dry land areas. With organic production and trade fast increasing globally, there is a growing interest in organic agriculture in the country. Traditional practices in India see the earth as a living being and there is still reluctance to exploit the earth for short gains. Traditional agricultural practices obviously can be improved and organic agriculture is the closest to the farmer's traditional customs, practices and beliefs (Mahale, 2002).

In 1983, the first training centre in organic agriculture was set up in Pondicherry under a project called Agriculture, Man and Ecology (AME), implemented by Educational Training Consultants, Leusden, the Netherlands and financed by the Government of the Netherlands. In October 1984, the association for the propagation of indigenous genetic resources organized the first conference on organic farming in Wardha. In 1992, the Rajasthan College of agriculture organized a national seminar on natural farming. In the same year, the first known study on ecological agriculture in South India was published (van der Werf and de Jager 1992). Since then, numerous farmers turned organic and important networks, such as ARISE (Agricultural Renewal in India for a Sustainable Environment), were established. In 1993, a directory of individuals and organizations involved in sustainable agriculture in India, called *Green Farming* was produced (Centre for Science and Environment 1993). In 1994, a register of 365 Indian organizations was published (ILEIA/ETC India 1994). Not all organizations were involved in organic agriculture, but all were at least related.

Government initiatives in promotion and regulation of Organic agriculture

National Programme of Organic Production (NPOP) launched by the Ministry of Commerce during 2001 and National Project on Organic farming (NPOF) launched during 2004 by the Department of Agriculture and Cooperation, Ministry of Agriculture were the two milestones towards institutionalization of organic farming in the country. The details of the two programs are:

National Programme of Organic Production (NPOP)

To provide a focused and well directed development of organic agriculture and quality products, Ministry of Commerce and Industry, Government of India, launched a National Program on Organic Production (NPOP) in the year 2000, which was formally notified in October 2001 under the Foreign Trade & Development Act (FTDR Act). It provides information on standards for organic production, systems criteria, and procedures for accreditation of inspection and certification bodies, the national organic logo and the regulations governing its use. The standards and procedures have been formulated in harmony with international standards such as those of Codex and IFOAM.

The NPOP proposes to provide an institutional mechanism for the implementation of National Standards for Organic Production, through a National Accreditation Policy and Program. The aim of the national program for organic production, inter alia, includes the following:

a. To provide the means of evaluation of certification programmes for organic agriculture and products as per the approved criteria.

b. To accredit certification programmes

c. To facilitate certification of organic products in conformity to the National Standards for Organic Products.

d. To encourage the development of organic farming and organic processing

Scope

The National Programme for Organic Production shall, among others, include:

(a) Policies for development and certification of organic products

(b) National standards for organic products and processes

(c) Accreditation of programmes to be operated by inspection and certification agencies

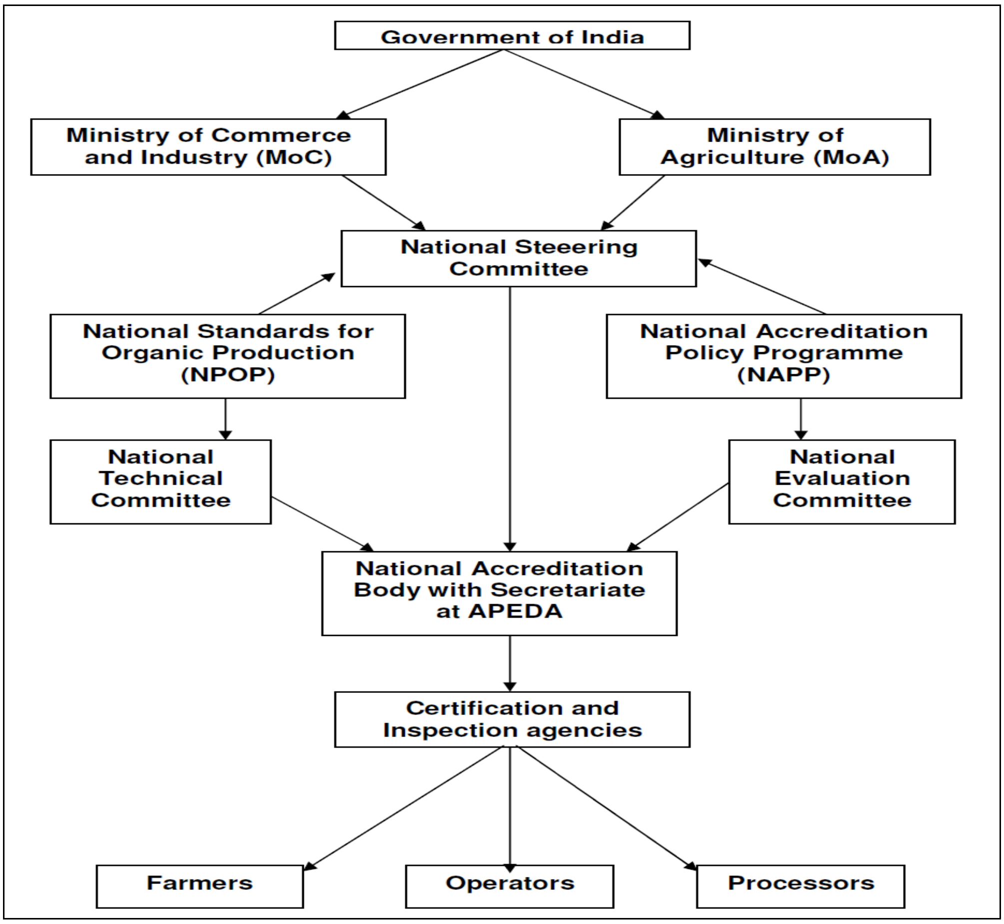
(d) Certification of organic products

Operational Structure

The operational structure of the National Programme for Organic Production is given in fig. 2.8. The program was developed and implemented by the Government of India through its Ministry of Commerce and Industry as the apex body. The Ministry constituted a National Steering Committee for NPOP, whose members will be drawn from Ministry of Commerce and Industry, Ministry of Agriculture, Agricultural and Processed Food Products Export Development Authority (APEDA), Coffee Board, Spices Board and Tea Board and other government and private organizations associated with the organic movement. To advise the National Steering Committee on relevant issues pertaining to National Standards and Accreditation, sub-committees were appointed. The National Steering Committee for National Program for Organic Production formulated a National Accreditation Policy and Program and drew up National Standards for Organic Products, which included standards for organic production and processes as well as the regulations for use of the National Organic Certification Mark. National Accreditation Policy and Program is administered by the National Accreditation Body, which would define the overall policy objectives for the Accreditation programmes and operations. The National Steering Committee may amend the Accreditation procedures whenever it deems fit. The National Accreditation Policy and Program is subject to periodic internal review, which will be conducted by the Technical Committee, which will advise the National

Steering Committee about the need and content of such amendments in the National Program for Organic Production.

Fig 2.8 Operational structure of NPOP



Source: NCOF, Ghaziabad

National Accreditation Body

The National Steering Committee would also function as the National Accreditation Body. The members of the National Accreditation Body shall comprise of representatives from Ministry of Agriculture, Ministry of Commerce and Industry, APEDA, Coffee Board, Spices Board and Tea Board. Recently, three more agencies (Coconut Board and Directorates of Cashew and Cocoa Development) were also included as representatives in this body. The Chairman of the Body shall be the Chairman of the National Steering Committee. The work of the National Accreditation Body will include: (a) Drawing up procedures for evaluation and Accreditation of certification programmes (b) Formulating procedures for evaluation of the agencies implementing the programmes and (c) Accreditation of inspection and certification agencies. Every certifier will implement a certification program and a program cannot be accredited without accrediting the certifier.

Evaluation Committee

Eligible Inspection and Certification Agencies implementing certification programmes will be evaluated by an Evaluation Committee. The Evaluation Committee will be appointed by the National Accreditation Body. The members of the Evaluation Committee comprised of members drawn from the APEDA, Coffee Board, Spices Board, Tea Board, Ministry of Agriculture and Export Inspection Council of India (EIC) / Export Inspection Agencies (EIAs). APEDA, on behalf of the National Accreditation Body, will receive and screen applications from the certification agencies, will coordinate and arrange evaluation visits etc to ascertain the credentials of certification programmes of the applicants. The Evaluation Committee will submit its recommendations to the National Accreditation Body for considering accreditation.

Accredited Inspection and Certification Agencies

Based on the recommendations of the Evaluation Committee, eligible Inspection and Certification Agencies will be accredited by the National Accreditation Body. These agencies should be well versed with the operating procedures, the NSOP and the international standards. Their programmes should have been in operation for at least one year and they should be able to provide the supporting documents.

Inspectors

The inspectors, appointed by the accredited Inspection and Certification Agencies will carry out inspection of the operations through records maintained by the operators as per specified formats and also by periodic site inspection. Based on compliance with the standards and certification programmes, accredited Inspection and Certification Agencies will certify the organic status of products and operations, specifying their conditions and recommendations.

National Project on Organic Farming (NPOF)

In 2000, Ministry of Agriculture also set up a task force on organic farming under the chairmanship of Kunwarjee Bhai Yadav. Based on their recommendations, the Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India has launched a Central Sector Scheme “National Project on Organic Farming during Xth Five year plan on pilot basis with an out lay of Rs.57.05 crore w.e.f. 1st October, 2004. The scheme is continuing in XIth Five year plan with an allocation of Rs.150 crore. Main objectives of this scheme are as follows:-

1. Capacity building through service provider
2. Financial support to different production units engaged in production of bio-fertilizers, compost, vermi-compost etc.
3. Human Resource Development through organizing training on certification and inspection, production and quality control of organic inputs, training of extension officers / field functionaries, farmers training on organic farming etc.
4. Field demonstration on organic inputs and enriched biogas slurry
5. Setting up of model organic farms
6. Market development for organic produce
7. Development of domestic standards
8. Support to new initiatives on technology related to organic farming
9. Awareness programmes etc.
10. Quality Control of various Bio-fertilizers and Organic fertilizers as per Fertilizer Control Order (FCO)

Operational structure

National Project on Organic Farming is being operated by the Integrated Nutrient Management Division of Department of Agriculture and Cooperation, GOI, and is headed by Joint Secretary (INM). The project objectives are being implemented and monitored through National Centre of Organic Farming (NCOF) at Ghaziabad as Head quarter with its six Regional Centers of Organic Farming (RCOF) located at Bangalore, Bhubaneshwar, Hisar, Imphal, Jabalpur and Nagpur.

Operational guidelines

Approved components are being implemented through National and Regional Centers of Organic Farming, through various State Govt Departments and agencies and through various Non-Government Agencies (NGOs). Details of operational methodologies for different components are as follows:

1. Capacity building through Service providers – Govt and non-government agencies, capable of forming farmer groups and well versed with certification system and internal control system management are being provided funds to convert 1500 farmers per group to organic, provide necessary technical support for optimum productivity and facilitate certification through grower group certification process.

2. Financial support to input production units – Financial support restricted to 25% of total financial outlay is being provided for the establishment of (i) Vegetable market waste compost, (ii) Bio-fertilizers and (iii) Vermiculture hatcheries. Non-government agencies, companies, entrepreneurs and individuals can avail the facility through credit linked back ended subsidy scheme. Loan can be availed from any scheduled bank and subsidy is reimbursed by NABARD or NCDC. Government and semi government bodies (including municipalities) can avail the subsidy directly by application to Department of Agriculture and Cooperation. Maximum ceiling of financial assistance is Rs. 40 lakh, Rs. 20 lakh and Rs. 1.5 lakh for Market waste compost, bio-fertilizers and vermiculture hatcheries respectively.

3. Training – Four different types of trainings, with different course contents are being arranged under NPOF through NCOF, RCOF and various government and non- government agencies. These are: (i) Training for inspection and certification agencies and service providers, (ii) Training on production and quality control of organic inputs, (iii) Training for field functionaries and extension officers on organic management and (iv)Training for farmers on organic farms.

4. Demonstrations – Field demonstrations-cum-farmer fairs on (i) organic inputs and (ii) enriched biogas slurry are being organized through NCOF, RCOF and various government and non-government agencies to prove the potential of organic management systems and different quality organic inputs.

5. Model organic farms – It is proposed to establish large number of model organic farms on government and government institutions' farms for demonstration of organic packages, development organic systems and production of organic seeds.

6. New Initiatives and market Development – Under the component funds are being provided to various government and non-government agencies for development of packages, evaluation of organic practices, development of market linkages and marketing initiatives. Funds are also being provided for documentation of practices and technologies and publicity of proven technologies.

7. Awareness creation – Funds are also being provided to NCOF, RCOF and various government and non-government agencies for organization of international/ national seminars, conferences, workshops, exhibitions etc and publicity through print and electronic media for mass awareness creation

Specific activities of NCOF and RCOFs

Besides, organization of trainings, ensuring implementation, monitoring and technical support to implementation agencies NCOF and RCOFs are also entrusted with some specific responsibilities, these include:

1. To collaborate all stakeholders of organic farming in the country and abroad and act as main information centre on various aspects of organic farming
2. Documentation of indigenous knowledge and practices, compilation of integrated organic packages and publication of technical literature in all the languages
3. Preparation and publication of uniform and authentic training literature and training course contents
4. Publication of Bio-fertilizers and Organic Farming Newsletters for national and international updates on quarterly and half yearly basis
5. To provide necessary technical assistance to production units for quality production of various organic inputs such as bio-fertilizers, composts etc.
6. To serve as data collection centre for bio-fertilizer and organic fertilizer production, bio-fertilizer and organic fertilizers production units and their production capacities and for details on total area under certification and various crops being grown under organic management

7. To maintain National and Regional culture collection bank of bio-fertilizer organisms for supply to production units
8. Development, procurement and efficacy evaluation of bio-fertilizer strains and mother cultures.
9. To act as nodal quality control laboratory for analysis of bio-fertilizers and organic fertilizers as per the requirement of Fertilizer Control Order.
10. To provide all sorts of technical assistance to implementing agencies for successful implementation of project targets.
11. Receiving, processing, evaluation and monitoring of project proposals, ensuring implementation of sanctioned components and surveillance on implementing agencies

Summary of achievements so far under NPOF

Under NPOF Department of Agriculture and Cooperation, Govt of India, has initiated systematic promotion of organic farming in the country in a project mode in specified areas. The summary of achievements of NCOF under NPOF is presented in table 2.20.

Table 2.20 Promotional activities taken up under NPOF

S. No.	Component	Achievements / sanctioned	Result
1.	Capacity Building through Service Providers	308	Farmers being converted to organic farming – 3,00,000 Area being brought under organic – 2,00,000 ha Area already brought under certification – 56,000 ha
2.	Support to Input production units		***Production Capacity installed /annum***
	1. Agro waste Compost Unit	15	5,000 MT
	2. Biofertilizers	24	3,000 MT
	3. Vermiculture	521	78,150 MT
3.	Trainings	1848	Benefiting more than 37,000 trainers, extension professionals and farmers
4.	Demonstrations	4126	Impact was demonstrated to more than 2 lakh farmers
5.	Establishment of model organic farms	232	For development of package and practices

Source: NCOF, Ghaziabad

More than 400 Government and Non-Government agencies are working under the project. More than 300 farmers groups, each comprising of about 1500 farmers have started functioning to bring about 200,000 ha land under organic certification process. With support to many organic production units a capacity has been created to produce about 5000 MT of vegetable market waste compost, 3000 MT of bio-fertilizers and 78,000 MT of earthworm culture. 1848 trainings organized under the project have benefited more than 37,000 trainers, extension professionals and farmers. Besides above more than 4100 demonstrations have been conducted and support has been provided for the establishment of 232 model organic farms through out the country (NCOF, Ghaziabad)

Certification and product labelling

Being able to put the word "organic" on a food product is a valuable marketing advantage in today's consumer market. Certification is intended to protect consumers from misuse of the term, and make buying organics easy. However, the organic labelling made possible by certification itself usually requires explanation. In many countries organic legislation defines three levels of organics. Products made entirely with certified organic ingredients and methods can be labelled "100% organic". Products with 95% organic ingredients can use the word "organic". Both may also display organic seal. A third category, containing a minimum of 70% organic ingredients, can be labelled "made with organic ingredients". In addition, products may also display the logo of the certification body that approved them. Products made with less than 70% organic ingredients can not advertise this information to consumers and can only mention this fact in the product's ingredient statement.

Certification around the world

Organic standards are formulated and overseen by the government in some countries. The United States, the European Union and Japan have comprehensive organic legislation, and the term "organic" may be used only by certified producers. In countries without organic laws, government guidelines may or may not exist, while certification is handled by non-profit organizations and private companies.

EU countries acquired comprehensive organic legislation with the implementation of the EU-Eco-regulation 1992. Certification is handled on the national level. In the United Kingdom, organic certification is handled by a number of organizations, of which the largest are the Soil Association and Organic Farmers and Growers. All the certifying bodies are subject to the regulations of the UK Register of Organic Food

Standards (UKROFS), which itself is bound by EU legislation. In Sweden, organic certification is handled by the private corporation KRAV.

In the US, the National Organic Program (NOP), was enacted as federal legislation in Oct. 2002. It restricts the use of the term "organic" to certified organic producers (excepting growers selling under $5,000 a year, who must still comply and submit to a records audit if requested, but do not have to formally apply). Certification is handled by state, non-profit and private agencies that have been approved by the US Department of Agriculture (USDA).

In Canada, the government has published a national organic standard, but it is a guideline only; legislation is in process. Certification is provided by private sector organizations. In Quebec, provincial legislation provides government oversight of organic certification within the province, through the Quebec Accreditation Board (*Conseil D'Accréditation Du Québec*). In Japan, the Japanese Agricultural Standard (JAS) was fully implemented as law in April, 2001. This was revised in November of 2005 and all JAS certifiers were required to be re-accredited by the Ministry of Agriculture.

In Australia, the Australian Quarantine and Inspection Service (AQIS) is the controlling body for organic certification because there are no domestic standards for organic produce within Australia. Currently the government only becomes involved with organic certification at export, meaning AQIS is the default certification agency. Although there is no system for monitoring the labeling of organic produce sold within Australia, this primarily affects the retail public. Commercial buyers for whom this is an issue have simply taken the export system as a de facto standard and are willing to pay premium prices for produce from growers certified under the National schemes. The largest importer of Australia's organic produce (by weight) is Japan (33.59%), followed by the UK (17.51%), France (10.51%), and New Zealand (10.21%). The largest certifier of organic products is Australian Certified Organic, which is a subsidiary of Biological Farmers Australia, the largest organic farmers' collective in the country.

In China, the China Green Food Development Center awards two Standards: A and AA; while the former standard does permit some use of synthetic agricultural chemicals, the latter is more stringent.

Internationally, equivalency negotiations are underway, and some agreements are already in place, to harmonize certification between countries, facilitating international trade. There are also international certification bodies, including members of the International Federation of Organic Agriculture Movements (IFOAM), the Organic Crop Improvement Association (OCIA), and Ecocert. Where formal agreements do not exist between countries, organic product for export is often certified by agencies from the importing countries, who may establish permanent foreign offices for this purpose.

Certification in India

In India, Agricultural Processed Foods Export Development Authority (APEDA) under Ministry of Commerce is the controlling body for organic certification for export. Till date there are no domestic standards for organic produce within India. Currently 18 certification agencies (see table 2.18) have been authorized to undertake certification process under National Programme for Organic Production (NPOP). Although there is no system for monitoring the labeling of organic produce sold within India, this primarily affects the retail public. Commercial buyers for whom this is an issue have simply taken the export system as a de facto standard and are willing to pay premium prices for produce from growers certified under the NPOP.

The regulation aimed to help domestic organic producers to overcome international trade barriers and reach a “level playing field”. Yet Indian regulation does not simplify the requirements for Indian exporters, nor does it reduce the costs. Agricultural products from India can be marketed as organic within the European Union (EU) under two exporting options for third countries: ‘Equivalence Granted’ and ‘Imports Granted’. Under the first option organic products can be exported if their production and inspection systems are considered as equivalent to those of the EU. That means India has to be recognized as having equivalent standards to those in the EU as defined in EU Regulation 2092/91. Secondly, since Indian local certifiers are not recognized by the EU, certification has to be issued by an EU approved certification body (by law already approved by the control authority in the EU importing country). Further, exporters in third countries are not allowed to apply directly for import authorization. So, Indian exporters have to depend on importers in individual EU member states to obtain special import permits from their respective EU control authorities. Moreover, import permits are issued for a defined period either for specific products or product groups from a given EU country. This operates as technical barriers to trade and increases transaction costs, continuing to hamper international trade. Recently, India's request to EU resolution for its inclusion in the third countries approved list has been approved. India has also been recognized for conformity assessment by USDA's NOP.

Participatory Guarantee Scheme (PGS)

Today, Third Party Certification systems have become the dominant means of organic guarantee for world trade and Indian producers have a number of respected and accredited Third Party Organic Certification agencies to choose from. While, it is an essential component to world trade, there are downsides to the system. The inherent expense and paperwork required in a multilevel system discourages most small organic producers from being certified at all. This limits local and domestic trade as well as access to organic products. Worse yet, it limits the growth of the organic movement as a whole.

Researchers have noted that the rapid increase in organic sales and certified acreage around the world is not matched by an equal rate of growth in the number of organic farms as might be expected. In Europe and much of the US, there is an ironic decrease in the number of certified producers even as total organic acreage and market sales continue to explode. (Eurostat's Statistics in Focus, Agriculture and Fisheries, 31/2005 and University of California, Davis, pre-published report, 2006). The result is? Big agribusiness farms are benefiting from certified organic status and market premiums more than the small scale producers that could most use these benefits. In an attempt to reduce the inequality of this trend, a number of alternative methods to guarantee the organic integrity of products have been developed for small domestic producers, and they are growing rapidly. Thousands of small scale producers now associate themselves with these alternatives programs, which are now collectively referred to as *Participatory Guarantee Systems* (PGS).

The Ministry of Agriculture, Government of India and FAO have undertaken a technical cooperation program for promotion of organic agriculture. One of the important components of this program is to explore and develop PGS as a means of organic guarantee for products produced and consumed within India. In 2006, the first PGS model for India was developed based on existing models around the world. It especially borrowed and built on the strengths of existing successful PGS programs in Brazil, New Zealand and the United States (see fig 2.9).

An effective Organic Guarantee System for India needs to address the issue of educating farmers as to the depth of what it means to be truly organic so that they can make a *choice* to farm organically or not. Such a guarantee needs to be affordable and easily accessible. It also needs to be as inclusive as possible so that every farmer that wants to make an informed, educated choice to be organic can do so and know that they are part of an important worldwide movement in agriculture today (Khosla, 2006).

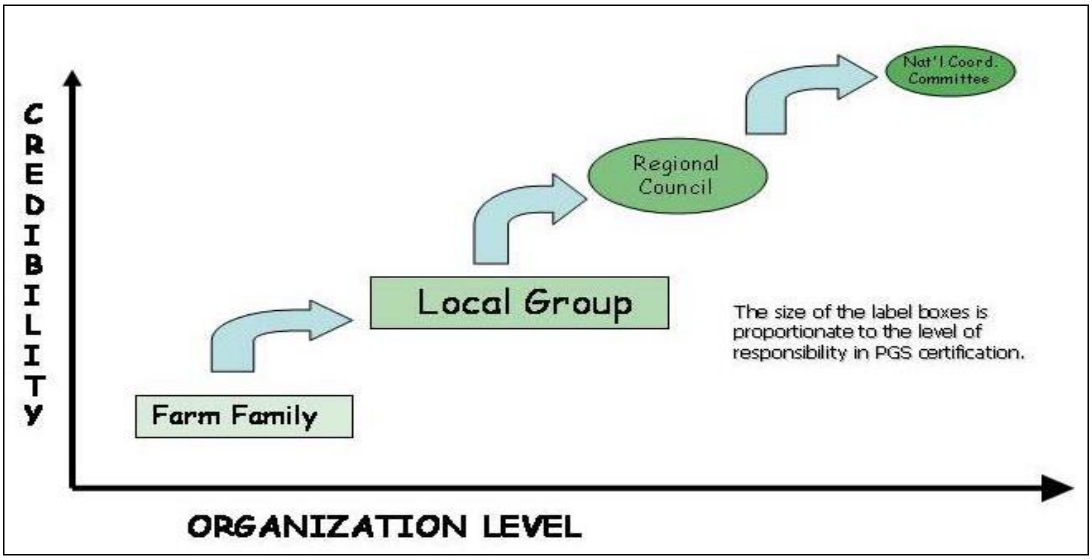


Fig 2.9 Key groups involved in PGS process

Institute for Integrated Rural Development (IIRD), Maharashtra

Though there are obvious benefits of organic cultivation and consumption, the small and marginal farmers face a challenge to guarantee their produce as organic in local and domestic markets. The third party certification process to guarantee organic produce involves exhaustive documentation and high costs which are beyond the capacity of the small farmers. As an alternative, a community based certification with local standards was pioneered by Dr. Alexander Daniel of Institute for Integrated Rural Development (IIRD), Aurangabad and implemented in Paithan Taluka of Maharashtra since 1998. This system called as Participatory Guarantee System (PGS) involves the farmers themselves in guaranteeing their produce as organic as per the norms and standards defined by the local group of farmers. The marketing of such produce is based on mutual trust and cooperation between consumers and producers and thus is more applicable for local and domestic marketing. This system is being implemented in different parts of the country as an alternative to the formal third party certification which benefits the small and marginal farmers.

IIRD involves in promoting organic agriculture as one of its main agenda and has promoted organic agriculture through awareness programmes, training of farmers, community action programmes on organic agriculture, networking with like minded organizations and lobbying nationally and internationally for organic agriculture. For its outstanding contribution to eco-centered development, IIRD received the international Sustainable Agriculture and Rural Development (SARD) award (Source: www.iird.org.in)

PGS is a certification system for the whole farm, allowing farmers to sell all the crops from the farm as certified organic. It empowers the farmer by putting them in control as key decision-makers of who is and isn't certified in their own local group. This means increased responsibility, but encourages social control as an important compliance mechanism. PGS is the only way to certify millions of small Indian farmers in a short amount of time, bringing them into a system of committed organic production. There is no way to fund the time or resources necessary to do that within ICS. On a global level there are three overall major issues which need consideration for a future successful development of PGS as a part of a credible organic guarantee system (Kallander, 2007) are: how to assist groups in setting up and developing a PGS, Recognition by government legislations and how to get the international recognition of PGS without losing its core principles and key features.

Growing certified area

Before the implementation of NPOP during 2001 and introduction of accreditation process for certification agencies, there was no institutional arrangement for assessment of organically certified area. Initial estimates during 2003-04 suggested that approximately 42,000 ha of cultivated land were certified organic. By 2005 India had brought more than 2.5 million ha of land under certification. Out of this while cultivable land was approximately 76,000 ha remaining area was forest land for wild collection. Growing awareness, increasing market demand, increasing inclination of farmers to go organic and growing institutional support has resulted into more than 200% growth in total certified area during the last two years. State wise area brought under certification process during 2005-06 and 2006-07 are given in table 2.21.

Table 2.21 Total Area under organic certification process (certified and under conversion) during the year 2005-06 and 2006-07

Sl. No.	State	Year	
		2005-06	**2006-07**
1	Andhra Pradesh	1661.42	10487.07
2	Arunchal Pradesh	557.76	830.24
3	Asam	1817.504	4032.94
4	Bihar	0	0
5	Chattisgarh	293.16	347.88
6	Delhi	1658.71	5965.28
7	Goa	5555.07	6950.3
8	Gujrat	1627.06	7760.82
9	Haryana	3437.52	3571.92
10	Himachal Pradesh	3647.41	9576.73
11	J & K	22315.92	32541.79
12	Jharkhand	5.00	2263.85
13	Karnataka	4117.17	11711.84
14	Kerala	15474.47	14744.66
15	Manipur	347.65	6019.55
16	Maharashtra	18786.69	114612.36
17	Madhya Pradesh	16581.37	163230.9
18	Mizoram	300.40	333.4
19	Meghalaya	378.89	0
20	Nagaland	718.76	7208.89
21	Orissa	26387.86	74585.11
22	Punjab	3779.31	1600.42
23	Rajasthan	22104.91	24868.23
24	Sikkim	177.64	1806.73
25	Tripura	20.87	0
26	Tamilnadu	5423.63	5066.48
27	Uttar Pradesh	3033.976	7301.47
28	Uttaranchal	5915.85	8676.74
29	West Bengal	6732.43	10534.11
30	Other	824.13	1540.84
	Total	**173682.54**	**538170.55**

Source: NCOF, Ghaziabad

Decreasing cost of certification

Prohibitively high cost of certification had always been a matter of concern for small and marginal farmers. But with the increasing competition, increasing number of producers and introduction of Grower Group Certification (GGC) system, per farmer costs have reduced drastically. The costs which were ranging from 1.5 to 2.0 lakh per individual project and Rs. 500 to 2500 per farmer in groups have come down to Rs. 45,000 to 75,000/- in case of individual projects and Rs. 100-150/- per farmer in groups. Recently, initiatives taken up by Government of India to promote State Government bodies as certification agencies has further reduced the prices.

Recently, the Uttarakhand State Organic Certification agency has started certification at a price of Rs. 10,000 to 15,000/- per project for encourage for farmers in the state.

Conversion standards

Organic agriculture means a process of developing a viable and sustainable agro-ecosystem. The time between the start of organic management and certification of crops and/or animal husbandry is known as the conversion period. The whole farm, including livestock, should be converted according to the standards over a period of three years.

Yields in irrigated farms may go down in the conversion period because yields are boosted by artificial fertilizers and on conversion soil fertility takes some years to increase. After that, yields are equal or even higher than during the conventional period. In rain-fed farming the situation is different. Yields here are significantly lower and thus the difference in yields between the conventional and conversion period is less. One of the basic constraints is the lack of governmental subsidies or support to make conversion to organic status easier or cheaper, as in the European Union and the United States. The conversion period can be very costly owing to the initial loss of yields and the high costs of inspection and ultimately certification, which have to be paid during the conversion period as well. Moreover, the products under conversion cannot be sold in the export market at a premium and normally are restricted to the conventional market (Mahale, 2002)

The length of the conversion period depends largely on the past land use and the ecological situation. The Indian standards prescribe that plant products produced annually can be certified organic when the National Standards stipulations have been met for a minimum of twelve months before the start of the production cycle, while perennial plants (excluding pastures and meadows) can be certified organic at the first harvest after at least 36 months of management according to the national standards stipulations (2.2.1, National Program of Organic Production). The accredited certifier can extend the conversion period depending on factors like past land use and environmental conditions (2.2.2, National Program of Organic Production).

Under “crop production”, it is stipulated that products under conversion may be sold as “Produce of organic agriculture in process of conversion”, or a similar description, when the National Standards stipulations have been met for at least twelve months. Animal products may be sold as "product of organic agriculture" only after the farm or relevant part of it has been under conversion for at least twelve months and provided the organic animal production standards have been met for the appropriate time. The certification program shall specify the length of time by which the animal production standards shall be met. With regard to dairy and egg production, this period shall not be less than 30 days. Animals present on the farm at the time of conversion may be sold for organic meat if the organic standards have been followed for 12 months.

Under the chapter “labelling”, it is recommended: “The use of in-conversion labels may be confusing to the consumer and is not recommended”. However, further on, it is stipulated that “The label for conversion products shall be clearly distinguishable from the label of organic products” (5.1.5, National Program of Organic Production).

Price structure for organic products

Often the prices expected by farmers are unrealistic. There have been many documented examples where a non-certified organic farmer wanted a price varying from 100-400 per cent more than comparable conventional products. A drop in the yields is often claimed as the reason for claiming a higher price. It is important to note that awareness rising for farmers is of equal importance as it is for consumers. Self-claimed organic agricultural produce can only be sold in the local market. But, a well defined organic market in the country is virtually non-existent. As for certified organic products, the situation is quite different in the export market. If the farmer has paid the costs for certification and thus owns the certificate and export directly, the premium is around 50 per cent. If he owns the certificate and sells it to an exporter, the premium is around 25-30 per cent. If he does not own the certificate, the premium is between 15 and 25 per cent (NCOF, Ghaziabad).

Future prospects

Although India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and only hope for rain fed resource poor farmers, the organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensure a debt free, profitable livelihood option. With in a short span of five years organic agriculture has grown from a controversial niche subject to a mainstream agriculture. It has grown at a rate of nearly 200% in the last two years and is likely to grow by more than 100% in the next five years to come. Institutional mechanisms and governmental support has ensured its sustained growth during the 11th plan period. But to keep the hopes of these farmers, efforts are necessary to link them to market. For this efforts need to be done on the same scale, as has been initiated for increasing the area.

****

Chapter III

Status of Organic Input Production in India

“Capital Investment Subsidy Scheme”, which is the major component under National Project on Organic Farming (NPOF) for setting up/promoting of organic input units in India. In the present day organic farming, more stress is given on-farm management. In this on-farm management, nutrient management and pests & disease management are the crucial parts. The requirement of these inputs mostly gets from own-farm resources other-wise partly from off-farm sources. The present chapter mainly describes the importance of quality inputs, briefly about capital investment subsidy scheme and current status of different organic inputs production in India.

3.1 Need for quality organic inputs

In promotion of organic farming, use of organic inputs has assumed greater importance. Contrary to conventional farming where synthetic inputs are used to feed and protect the crop by direct action, in organic farming, inputs are used to feed the soil and to create an environment which can collectively keep the pests below economical threshold limit (ETL). In this endeavor although quantity may not be an important issue, but quality of input is of prime importance. In the recent years efforts have been made to promote appropriate production methodologies among farmers for effective conversion of organic waste into nutrient rich compost and for preparing botanical extracts for pest management. Mass adoption of vermi-compost technology and use of Neem seed kernal sprays by farmers is an indicative of the usefulness of such strategy. But still there is a scope for the entrepreneurs to come forward and establish production facility to produce consistent quality products and made available to farmers at reasonable prices. To take the advantage of growing awareness of organic agriculture, various types of organic and biological inputs have been launched and are being sold to farmers. Most of such products are the results of research, but some are promoted without much scientific validity. To prevent such adulterated practices, awareness among the farmers is most essential. At government level, efforts have been taken to regulate the production and quality control of some organic inputs through Fertilizer Control Order (for composts and bio-fertilizers) and Central Insecticide Act (for manufacture and sale of bio-pesticides) (NCOF, Ghaziabad).

3.2 Capital incentive subsidy scheme for promotion of organic inputs

The critical component of organic farming is availability of organic inputs. Organic manures are an important input for promotion of organic farming as well as for Integrated Plant Nutrient Management (IPNM) in traditional farming. Accordingly, capital investment subsidy scheme for commercial production units for organic inputs under NPOF has been introduced since October, 2004 with the following objectives:

a. To promote organic farming in the country by making available the organic inputs such as bio-fertilizers, vermi-compost and fruit & vegetable waste compost and thereby better return for the produce;
b. To increase the agricultural productivity while maintaining the soil health and environmental safety;
c. To reduce the total dependence on chemical fertilizers by increasing the quantum of quality bio-fertilizers / compost availability in the country;
d. To set up hatcheries for vermin-culture so that the demand of enough earthworm population for on farm production of vermi-compost can be met with;
e. To convert the organic waste in to plant nutrient resources; and
f. To prevent pollution and environment degradation by proper conversion and utilization of organic waste

New as well as existing units (for expansion / renovation) engaged in the production are eligible under the scheme. For setting up of organic input production units, financial assistance is being provided as credit-linked and back-ended subsidy through National Bank for Agriculture and Rural Development (NABARD) and National Cooperative Development Corporation (NCDC). The financial assistance for setting up the following types of organic input units are:

1. ***Fruit/vegetable and agro-waste compost production units*** of 100 TPD capacity with financial assistance @ 25% of the total project cost subject to a maximum of Rs. 40.00 lakh per unit
2. ***Bio-fertilizer production units*** of 150 TPA capacity with financial assistance @ 25% of the total project cost subject to a maximum of Rs. 20.00 lakh per unit

3. ***Vermi culture hatcheries*** of 150 TPA capacity with financial assistance @ 25% of the total project cost subject to a maximum of Rs. 1.50 lakh per unit

The pattern of assistance will be owner's contribution 25 per cent, subsidy from the government of India 25 per cent subjected to the maximum ceiling and the remaining 50 per cent as a term loan from the bank. The rate of interest on the loan is as decided by the financial bank. Prescribed time limit for establishment of units and repayment of loans under NPOF are summarized in tables 3.1 and 3.2 respectively.

Table 3.1 Time limit for establishment of units

Bio-fertilizers units	Vermiculture hatcheries	Fruit & vegetable waste compost unit
A time limit of maximum 12 months is prescribed for completion of the project from the date of sanction by bank	A time limit of maximum 6 months is prescribed for completion of the project from the date of sanction by bank	A time limit of maximum 12 months is prescribed for completion of the project from the date of sanction by bank

However, if reasons for delay are justified, a further grace period of 3 months may be allowed by the participating bank. If the project is not completed within stipulated period, the benefit of subsidy shall not be available and advance subsidy has to be refunded.

Table 3.2 Prescribed time limits for repayment of loan

Bio-fertilizers units	Vermiculture hatcheries	Fruit & vegetable waste compost unit
Repayment period will depend upon the cash flow and may be generally up to 10 years with a grace period of two years.	Repayment period will depend upon the cash flow and may be generally up to 8 years with a grace period of one year.	Repayment period will depend upon the cash flow and may be generally up to 10 years with a grace period of two years

Refinance assistance from NABARD: NABARD releases subsidy to the units financed by commercial banks, Regional Rural Banks (RRBs), State Cooperative Banks (SCBs), State Co-operative Agricultural and Rural Development Banks (SCARDBs), Scheduled Primary Urban Cooperative Banks (PUCBs), and such other institutions eligible for refinance from NABARD.

The total subsidy amount will be released in two installments. 50 per cent of the eligible subsidy would be released as Advance subsidy to the participating bank upon submission of a project profile cum claim form after sanction of bank loan and disbursement of first installment. The remaining 50 per cent as Final subsidy would be disbursed to the participating bank after conduct of an inspection by the Joint Monitoring Committee (JMC) consisting of officials from the financial bank, NABARD and NCOF/Department of Agriculture and Cooperation (DAC) officials. No interest should be charged on the subsidy portion by the bank. The state-wise details of units' sanctioned under NABARD as on May, 2009 are presented in table 3.3.

Table 3.3 State-wise details of input units' sanctioned under NABARD

s.no	State	Vermi-hatchery units	Bio-fertilizer units	Fruit and vegetable waste units
1	Andhra Pradesh	5	6	-
2	Assam	21	-	1
3	Bihar	7	-	-
4	Chattisgarh	6	-	-
5	Delhi	-	-	1
6	Goa	-	1	1
7	Gujarat	86	3	1
8	Himachal Pradesh	1	1	-
9	Jharkhand	1	-	-
10	Karnataka	35	1	2
11	Kerala	1	2	2
12	Madhya Pradesh	22	1	-
13	Maharashtra	29	6	-
14	Meghalaya	-	1	-
15	Punjab	42	1	-
16	Haryana	8	1	-
17	Rajasthan	63	1	-
18	Tamil Nadu	5	2	1
19	Uttar Pradesh	115	-	1
20	Uttarakhand	1	2	-
21	West Bengal	7	2	-
	Total	455	31	10

Source: Head office, NABARD (as on May, 2009)

Refinance assistance from NCDC: The Ministry of Agriculture, DAC under the NPOF requested NCDC for setting up of 5 bio-fertilizer units in co-operative sector with back ended subsidy @ 25 per cent of the total block cost subjected to a maximum of Rs.20 lakh per unit. The establishment of fruit and vegetable waste production units and vermi-culture hatcheries were not assigned to the corporation.

The original Total Financial Outlay (TFO) sanctioned by the bank or the actual expenditure incurred by the promoter, whichever is less, will be reckoned for deciding the amount of subsidy subject to verification by the Joint Monitoring Committee (JMC). NCDC has so far sanctioned two bio-fertilizer projects through the state government of Maharashtra. The details of these units are presented in table 3.4.

Table 3.4 Details of bio-fertilizer units sanctioned under NCDC

Sl.no	Details of the unit
1.	The Ganpati Zila Krishi Audhoyogic Sarva Seva Sahakari Society Ltd., Vasandada Market Yard, Sangli, Maharashtra
2.	Sanjeevani Agro Products Cooperative Society Ltd., Ichalkaranji Tal, Hatikanangale Dist, Kolhapur, Maharashtra

Basic organic input demand framework

The performance and capacity utilization of any organic input will depend on a wide range of factors including the local area. But, a basic organic input demand framework is depicted in fig 3.1. Basically, the demand depends up on the crops growing in that area (irrigated/rain fed), interests of farmers (short or long term) and market demand for organic produce. It also depends up on the organic output premium prices and presence of output marketing channels. The timely availability of organic inputs and existence of established input marketing channels also influence the sales.

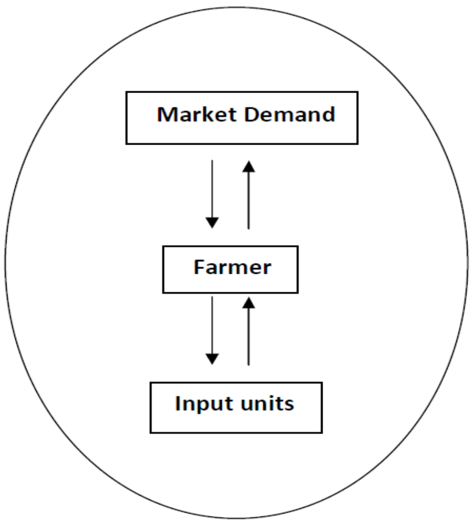


Fig 3.1Organic input demand framework

3.3 Status of organic input production

Recycling nitrogen on the farm by using manure and nitrogen fixing plants enhances soil quality and provides nutrients. This is the predominant technique of organic and low external input agriculture. However, timing and management of its use are essential. Soil mineralization processes should deliver the elements to the plant at times of peak demand. Organic and green manures as well as nitrogen from legumes can be managed very precisely due to the design of the crop rotations including cover and catch crops (Thorup-Kristensen, *et al.,* 2003). In addition, improved distribution systems, such as slurry injections into soils or drag hoses, reduce nutrients losses considerably. All these techniques might be knowledge-intensive for farmers and require site specific adaptations. As nitrogen on organic farms is far more costly than industrial nitrogen, there is a strong incentive to avoid losses and to learn and implement recycling techniques (Stolze, *et al.*, 2000).

The global potential of nitrogen availability through recycling and nitrogen fixation is far bigger than the current production of synthetic nitrogen, as shown table 3.5.

Table 3.5 Global nitrogen input and nitrogen circuits in agriculture

Nitrogen derived from industrial production (by the Haber-Bosch process with fossil fuel combustion)	90 to 100 Mt N per year	Erisman, *et al*., 2008, IFA, 2009
Potential nitrogen production by leguminous plants via intercropping and off-season cropping (without competing cash crops). This potential is not used by conventional farmers.	140 Mt N per year	Badgley, *et al.,* 2007
Nitrogen from livestock faeces of 18.3 billion farm animals (FAO, global figure). In specialized farming structure with strong segregation between crop and livestock production, nitrogen from manure and slurry is inefficiently used.	160 Mt N per year	Niggii *et al.,* 2009

On-farm use of farmyard manure (a practice increasingly abandoned in conventional production) needs to be reconsidered in the light of several problems in the conventional farming. In addition, different forms of compost, especially composted manure, are particularly useful in stimulating soil microbial processes and in building up stable forms of the soil organic matter (Fließbach and Mäder, 2000). N-application rates in organic agriculture are usually 60 to 70 percent lower than in conventional agriculture because of the recycling of organic residues and manures.

In addition, the limited availability of nitrogen in organic systems requires careful, efficient management (Kramer, *et al.*, 2006).

India's potential

Bhattacharya and Chakraborty (2005) estimated the current status of organic farming in India and other countries. They noticed various problems in the conventional farming in India and opined that the integration of organic and inorganic farming would be an ideal model. Based on their results the industrial nitrogen fixation (INF) is 40 mt/year which accounts for only 15.3% of total nitrogen fixation. On the other hand, the quantity of biological nitrogen fixation (BNF) is 175 mt/year contributes for 67.3% of the total amount. Plant also uses nutrients from organic sources through mineralization and billions of microorganisms are available in soil for this job. Excess and indiscriminate use of inorganic fertilizer has deteriorated soil badly with deficiency of macro and micronutrients.

India is endowed with various types of naturally available organic form of nutrients in different parts of the country and which will help for organic cultivation of crops substantially. According to Bhattacharya (2006) the major sources of organic inputs in India are presented below:

Sources of organic inputs in India

Live stock	=	2.47 million ton
Crop residues	=	2.00 million ton
Biogas slurry	=	0.12 million ton
Bio-fertilizer	=	0.20 million ton
Green manure	=	0.10 million ton
City refuse	=	0.68 million ton
Others*	=	1.00 million ton
Total	=	6.57 million ton
Bio-pesticide	=	1000 ton

* Rural compost, vermi-compost, ag. wastes

There is enough scope for production of sufficient organic inputs in India. Almost 7 million ton of production potential currently is having through different sources. Among different sources, livestock accounts for lion share (nearly 40 per cent). It is followed by crop residues (30 per cent) and other sources (15 per cent). Other sources include the rural compost, vermi-compost and agricultural wastes. India is also having a huge potential of nearly 1000 tons of bio-pesticide preparations.

Ghosh (2004) analyzed the environmental benefits of possible shift in agricultural technology, while keeping in view the importance of sustaining crop yield levels and protecting farmers' incomes. She considered two major crops i.e., paddy and groundnut from major producing states of India and found that over time while fertilizer use intensified several times, the use of manure in agriculture either stagnated or declined. Quadratic yield functions were fitted on cross-section household level data by using prices faced by farmers as reported by official surveys and found that in majority of the cases there will not be any financial loss resulting from a small shift in technology towards organic manure. The interactions between the two inputs vary but a synergic effect dominated for paddy. But substitution of organic manure for chemical fertilizer seems technically possible to protect yield levels and simulations suggested that a shift towards manure from fertilizer on the whole may not hurt income in most cases. However since the effect differs by households and depends on the response of manure price to increased use, the shift can be practicable if losing households are protected or compensated by policy and by promoting a more dynamic manure market to control manure prices. Higher premiums on output prices if possible in a market for a product embodying a more sustainable technology could be another way in which farm incomes can be protected.

Installed capacity of compost/vermi-compost units

The state-wise details of organic manure production units sanctioned under different state and centre governmental schemes are summarized and presented in table 3.6. The units sanctioned under NPOF subsidized scheme are not included in the table. Since most of the states have not submitted the data, it was denoted as '0'. The state-wise number of units established and their installed capacities respectively under NADEP compost, vermi-compost and other compost types are summarized in the table. The total no.of NADEP compost units built across India was 248622. The total installed capacity of these units was 18.704 lakh metric tons. The average installed capacity of each NADEP compost pit was around 7.5 ton. Nearly, 72 per cent of the units were established in Madhya Pradesh state followed by U.P (24 per cent). 178564 units of vermi-compost units were sanctioned across under different state and centre government schemes. The estimated installed capacity of these units was 32409.2 lakh metric tons. Due to some inconsistency in the production data, we are not attempting any further calculations. The lion share of these were sanctioned in U.P (33.3 per cent) followed by Rajasthan (26 per cent). The total number of other compost units approved under these schemes was 232730. The additional capacity created under these units was 15.2 lakh metric tons. The mean capacity of a single unit was approximately 6.5 ton. Nearly, 68 per cent of these units were approved in Karnataka state followed by Maharashtra (27 per cent).

Table 3.6 State-wise details of organic manure production units, 2007-08*

Sr. No	Name of the State	NADEP compost (no.)	Capacity generated (lakh mt)	Vermi-compost units (no.)	Capacity generated (lakh mt)	Other compost units (no.)	Capacity generated (lakh mt)
1	Andhra Pradesh	0	0	1441	0.043	41	0.016
2	Arunachal Pradesh	0	0	115	0.01	0	0
3	Assam	0	0	1133	0.11	20	0.002
4	Bihar	0	0	0	0	0	0
5	Chhattisgarh	3892	0.38	8467	0.32	6362	0.63
6	Goa	0	0	13	0	352	0.06
7	Gujarat	0	0	6768	0.07	0	0
8	Haryana	0	0	0	0	0	0
9	Himachal Pradesh	0	0	9	0.59	0	0
10	Jammu & Kashmir	0	0	59	0	0	0
11	Jharkhand	0	0	9	0.50	0	0
12	Karnataka	4	5.84	33	0.26	156892	13.48
13	Kerala	0	0	5200	4.16	0	0
14	Madhya Pradesh	179602	5.4	13414	0.20	0	0
15	Maharashtra	441	0.014	21219	1.07	61703	0.77
16	Manipur	0	0	18	0	0	0
17	Mizoram	0	0	0	0	0	0
18	Orissa	0	0	710	0.0139	0	0
19	Punjab	0	0	0	0	0	0
20	Rajasthan	0	0	45897	0.52	0	0
21	Sikkim	0	0	12786	0.50	6410	0.20
22	Tamilnadu	0	0	765	32400	0	0
23	Tripura	0	0	50	0	0	0
24	Uttar Pradesh	59683	6.26	59498	0.832	0	0
25	Uttrakhand	5000	0.81	0	0	0	0
26	West Bengal	0	0	960	0.048	950	0.047
	Total	248622	18.704	178564	32409.2469	232730	15.205

0- means information is not available

* *Units funded under state and central governmental financial assistance schemes, excluding the units subsidized through NPOF*

Source: NCOF, Annual Report, 2007-08

Status of compost/vermi-compost production

The state-wise details of compost/vermi-compost production and area covered by them are presented in table 3.7. The production details were categorized in to five types i.e., rural compost, urban compost, FYM, vermi-compost and other composts. The total production of rural compost at all India level was 1693.2 lakh ton. The total area covered by these units was 697.4 lakh ha.

Table 3.7 State-wise details of compost/vermi-compost production, 2007-08*

Sr. No	Name of the State	Rural Compost		Urban compost		FYM		Vermicompost		Other manures	
		P&A	AC	P&A	AC	P&A	AC	P&A	AC	P&A	AC
1.	Andhra Pradesh	47.09	4.79	1.05	0.11	300.0	30.0	1.0	0.4	0.5	0.5
2	Arunachal Pradesh	0	0	0	0	0.1	0.01	0.01	0.01	0	0
3	Assam	0.76	0.38	0	0	81.36	8.13	0.25	0.12	0	0
4	Bihar	21.38	61.8	0.015	0	0	0	0.14	0	0.25	0
5	Chattisgarh	13.2	13.0	0.09	0.04	20.68		0.666	0	15.35	0.6
6	Goa	0.4	0.02	0.04	0	0.22	0.01	0.01	0.01	0	0
7	Gujarat	0	0	0	0		0	0.5	0.12	1.70	0.34
8	Haryana	32.50	0	0	0	7.05	0	0.73	0	0	0
9	Himachal Pradesh	6.80	2.5	0.04	1.0	0	0	0.65	0.66	0	0
10	Jammu & Kasmir	0.95	0.05	0.10	0	2.5	0.12	0.25	0	0	0
11	Jharkhand	0	0	0	0	0	0	0.41	1.40	0	0
12	Karnataka	1016.22	508.11	143.54	71.77	1665.12	832.50	13.56	6.78	64.62	40.50
13	Kerala	0.80	0	0.04	0	122.05	15.20	4.16	0	8.02	0.67
14	Madhya Pradesh	0	0	0	0	0	0	0	0	0	0
15	Maharashtra	0.41	0	0	0	0	0	1.07	0.24	0	0
16	Manipur	81.0	0	0	0	6.27	0.73	0	0	0	0
17	Mizoram	0	0	0	0	0.002	0	0.003	0	0.002	0
18	Nagaland	0	0	0	0	0	0	0	0	0	0
19	Orissa	21.38	61.80	0.015	0	0	0	0.139	0	0.25	0
20	Punjab	312.00	20.40	0.008	0	3.00	0.29	0.15	0.07	0	0
21	Rajasthan	69.50	0	1.05	0	0	0	2.48	0	0	0
22.	Sikkim	0.26	0.06	0	0	0	0	0.50	0.25	0.24	0.06
23	Tamilnadu	18.68	9.34	6.66	3.33	10.56	2.11	0.4	1.04	0	0
24	Tripura	0	0	0	0	0	0	0	0	0	0
25	Uttar Pradesh	6.26	0.62	0	0	0	0	0.83	0.16	0	0
26	Uttrakhand	0	0	0	0	4.50	1.09	1.50	0.60	0	0
27	West Bengal	43.65	14.55	0	0	40.95	12.6	1.55	0.77	1.15	1.2
	Total	**1693.24**	**697.42**	**152.648**	**76.25**	**1862.002**	**864.65**	**30.958**	**12.63**	**92.082**	**43.87**

P&A- Production and Availability (lakh tones),
AC- Area covered (lakh ha).

* based on the inputs provided by different state government during Oct, 2008
Source: NCOF, Annual Report, 2007-08

Among different states, the maximum production (60%) and area (73%) was covered under Karnataka state. In case of urban compost, the cumulative total production was 152.6 lakh ton. The covered area was only 76.2 ha. The total urban compost is only accounted for 9 per cent share in the total rural compost production. Between different states, Karnataka occupied the lion share in the total. The total production and coverage of area under farm-yard manure units was 1862 lakh ton and 864.6 lakh ha respectively. The average application rate per ha was 2.15 ton. Again Karnataka is on the top list when compared with other states. The total production of vermi-compost from all the states was 30.9 lakh tons. Approximately 12.63 lakh ha area was covered by these units. Almost half of the production and area was covered in Karanataka alone. The average application was 2.44 ton per ha. In case of other compost units, the total production made by them was 92.0 lakh tons with an area coverage of 43.8 lakh ha. The average application of this compost was 2.1 ton per ha. Karnataka state secured the major share both in production and area coverage.

Status of green manure production

The status of green manure production across different states is presented in table 3.8. Incorporation of green manure improves the soil physical characteristics as well as fixes the biological nitrogen significantly. The total green manure production at the all India level was 133.5 lakh metric tons with 13.0 lakh ha area coverage. The major green manure producing states were Uttar Pradesh followed by Chattisgarh and Tamil Nadu. But, more 50 per cent of the total area was covered in Karnataka.

Table 3.8 Status of green manure production across different states, 2007-08

Sr. No	Name of the State	Green Manure	
		Production/ Availability/Distribution of seed (lakh mt)	Area covered (lakh ha)
1.	Andhra Pradesh	18.75	1.88
2	Arunachal Pradesh	0	0
3	Assam	0	0
4	Bihar	0	0
5	Chattisgarh	11.54	0.05
6	Goa	0.65	0.21
7	Gujarat	0	0
8	Haryana	0	0
9	Himachal Pradesh	0	0
10	Jammu & Kasmir	0	0
11	Jharkhand	0	0
12	Karnataka	6.22	7.78
13	Kerala	0.025	0
14	Madhya Pradesh	0	0
15	Maharashtra	0.13	0
16	Manipur	0	0
17	Orissa	0	0.15
18	Punjab	0	0
19	Rajasthan	0	0.19
20	Sikkim	0	0
21	Tamilnadu	10.73	0.71
22	Uttar Pradesh	79.8	0.79
23.	Uttrakhand	3.60	0.20
24	West Bengal	2.15	1.07
	Total	**133.595**	**13.03**

Source: NCOF, Annual Report, 2007-08

Status of bio-fertilizer production

The details of production of bio-fertilizers between 2004-05 and 2007-08 are presented in table 3.9. Various types of bio-fertilizers are being produced by many producers in the country. Among these, Rhizobium, Azotobacter, Azospirillum and PSB are most predominant ones. The production and growth of different bio-fertilizers between the years 2004-05 and 2007-08 is the indication of increased awareness of farmers regarding use of bio-fertilizers in the country. Among different bio-fertilizers, the production of PSB is highest followed by Rhizobium, Azospirillum, Azotobacter, and Acetobacter during 2007-08. But, when we compare with base year, 2004-05; the highest growth was observed in case of Azospirillum followed by Rhizobium and Azotobacter.

Table 3.9 Production of different bio-fertilizers, 2004-05 to 2007-08 (tons)

Type	Production 2004-05	Production 2007-08	% change
Azotobacter	1790.18	3360.8	+87.7
Azospirillum	871.21	2944.5	+227.9
Acetobacter	92.08	-	-
Rhizobium	1188.35	2825.8	+137.7
PSB	6653.01	10675.9	+60.4
Others*	12071.1	18821.6	+55.9
Total	22665.9	38932.6	+71.7

* Others includes compost enriches (Trichoderma, Paceliomyces etc), PGPRs, BGA etc
Source: NCOF, Annual Report, 2004-05 and 2007-08

Installed capacity and current utilization

The details of state-wise installed capacity and production of bio-fertilizers are summarized in table 3.10. According the information gathered by NCOF /RCOF's there are 164 bio-fertilizer units existing in the country. But, besides these there may be many private units, State Agri. Labs and SAUs and other agencies which also producing bio-fertilizers. However, the production figures of such units were not included in the present table. During the year 2007-08, the details about installed capacity and current production were collected from all 164 units. The total installed production capacity of all the units was 67162 tones. But, the actual production during 2007-08 was only 38932.6 tones. It accounts for nearly 58 per cent of their total capacity utilization. Among different states, the highest installed capacity was observed in case of Karnataka (nearly 40 per cent) followed by Tamil Nadu (19 per cent). The lowest installed capacity was indicated in case of Punjab. But, their shares in the total production was the highest in case of Tamil Nadu (28 per cent) followed by Karnataka (22 per cent). Across different states, the highest capacity utilization was noticed in case of Pondicherry (189.2 per cent). These results conclude that there is ample scope for further increase in production of bio-fertilizers in the country. The table 3.10 also reveals that most of the installed capacity and production was concentrated only in southern states. There is a huge untapped potential in case of north and north eastern states.

Table 3.10 State-wise installed capacity and production, 2007-08 (tons)

S. No.	State	Installed Capacity	Total Biofertilizer Production (MT)	Other Inoculants (MT)*	Total Production (MT)
1	Andhra Pradesh	7025	4515.81	65.164	4580.97
2	Assam	290	70.901	0	70.90
3	Bihar	150	20	0	20.00
4	Delhi	1000	168.844	575.812	744.66
5	Gujarat	1850	1263.30	32.18	1295.48
6	Goa	150	0	46.513	46.51
7	Haryana	50	8.89	0.01	8.90
8	Himachal Pradesh	75	56.21	0	56.21
9	Jharkhand	220	201.68	0	201.68
10	Kartnataka	26425	2841.27	5584.62	8425.89
11	Kerala	5855	814.45	3743.39	4557.84
12	Madhya Pradesh	1725	1884.87	34.3	1919.17
13	Maharashtra	5775	2486.41	258.16	2744.57
14	Mizoram	25	3.58	0	3.58
15	Nagaland	150	13.98	0	13.98
16	Orissa	430	331.94	13	344.94
17	Punjab	2	2	0	1.70
18	Pondicherry	890	471.29	1213.40	1684.68
19	Rajasthan	800	302.30	0	302.30
20	Tamil nadu	12825	3466.97	7250.88	10717.85
21	Tripura	30	14.27	0	14.27
22	Uttar Pradesh	315	250.06	4	254.27
23	West Bengal	1105	922.34	0	922.34
	Total	**67162.00**	**20111.05**	**18821.639**	**38932.689**

* Others includes compost enriches (Trichoderma, Paceliomyces etc), PGPRs, BGA and Azolla
Source: NCOF, Annual Report, 2007-08

Scenario of bio-fertilizer production across different states

The scenario of bio-fertilizer production across different zones and states is presented in table 3.11.

Table 3.11 Scenario of bio-fertilizer production in India, 2003-04 to 2007-08 (tons)

Sl. No.	Name of the State	Years				
		2003-2004	2004-2005	2005-2006	2006-2007	2007-08
	South Zone					
1	A & N Islands	0	0	0	0	0
2	Andhra Pradesh	205.00	2019.50	2246.43	4500.619	4515.81
3	Daman & Diu	0	0	0	0	0
4	Karnaraka	1083.40	1135.86	612	341.64	2841.269
5	Kerala	54.85	213.25	8.34	261.75	814.447
6	Lakshadweep	0	0	0	0	0
7	Pondicherry	22.62	0	7.78	1827.78	471.286
8	Tamil Nadu	1845.50	1564.94	2207.58	1770.29	3466.966
	Total	3211.37	4933.55	5082.13	8702.079	12109.778
	West Zone					
9	Chhatisgarh	86.95	0	0	0	0
10	Gujarat	1034.85	943.00	1371.60	1250.63	1263.301
11	Goa	0	0	0	3.5	0
12	Madhya Pradesh	1300.45	1333.94	823.07	1204.76	1884.867
13	Maharashtra	3035.00	3049.98	2098.96	2425.959	2486.41
14	Rajasthan	590.01	30.64	430.59	339.75	302.303
15	D & N Haveli	0	0	0	0	0
	Total	6047.26	5357.56	4724.22	5224.599	5936.88
	North Zone					
16	Delhi	0	1.36	1.23	0	168.844
17	Chandigarh	0	0	0	0	0
18	Haryana	22.54	20.16	23.48	30.22	8.89
19	Himachal Pradesh	9.48	10.30	9.59	0	56.21
20	Jammu & Kashmir	0	0	0	0	0
21	Punjab	2.95	0.37	2.27	2	1.7
22	Uttar Pradesh	115.98	130.27	486.30	212.78	250.057
23	Uttaranchal	0	0	0	0	0
	Total	150.95	162.46	522.87	245	485.701
	East Zone					
24	Bihar	0	15.00	41.00	36.9	20
25	Jharkhand	0	0	9.00	205.62	201.68
26	Orissa	59.31	32.62	65.97	280.54	331.94
27	West Bengal	226.53	74.296	194.60	1406.48	922.34
	Total	285.84	121.916	310.57	1929.54	1475.96
	North East Zone					
28	Arunachal Pradesh	0	0	0	0	0
29	Assam	88.50	25.20	107.60	8.465	70.901
30	Manipur	0	0	0	0	0
31	Meghalaya	0	0	0	0	0
32	Mizoram	1.14	0	0	1.68	3.58
33	Nagaland	8.03	0	17.03	10.65	13.98
34	Sikkim	0	0	0	0	0
35	Tripura	5.80	0	0	23.25	14.27
	Total	103.47	25.20	124.63	44.05	102.73
	Grand Total	**9798.89**	**10600.686**	**10764.42**	**16145.263**	**20111.05**
Data compiled is based on information received from State Govt/Regional Centres/NGOs/Pvt Production units						

Source: NCOF, Annual Report, 2007-08

The total production of bio-fertilizers in the country has increased from 9798.8 ton to 20111.0 tons between 2003-04 and 2007-08. It registered a growth of more than 100 per cent. It shows that the demand about bio-fertilizers in the country is increasing at the rate of 20 per cent per annum. In absolute terms, the demand has increased significantly in south zone when compared to other zones. The demand was almost stagnant in case of west and north east zones. Among different states, the highest growth in production was observed in Andhra Pradesh from 205 tons to 4515.8 tons during the study period.

Different types of bio-fertilizer production across states

The information about different types of bio-fertilizer production across states is presented in table 3.12.

Table 3.12 Different types of bio-fertilizer production across states, 2007-08 (tons)

Sl. No.	Name of State	Biofertilizer Production during the year 2007-08						
		Azotobacter	Azospirillum	Rhizobium	PSB	Total BF	Other Inoculants *	Grand Total
1	Andhra Pradesh	566.454	519.697	874.154	2555.505	4515.81	65.164	4580.974
2	Assam	13.079	17.29	6.769	33.763	70.901	0	70.901
3	Bihar	0	0	0	0	20	0	20
4	Delhi	53.645	51.316	4.802	59.081	168.844	575.812	744.656
5	Gujarat	375.42	129.08	105.691	653.11	1263.301	32.18	1295.481
6	Goa	0	0	0	0	0	46.513	46.513
7	Haryana	2.02	0	1.49	5.38	8.89	0.01	8.9
8	Himachal Pradesh	12.25	15.01	13.7	15.25	56.21	0	56.21
9	Jharkhand	75	25	15	75	201.68	0	201.68
10	Kartnataka	353.318	691.407	102.929	1693.615	2841.269	5584.62	8425.889
11	Kerala	28.271	146.168	158.804	481.204	814.447	3743.392	4557.839
12	Madhya Pradesh	221.874	5.333	510.265	1147.395	1884.867	34.3	1919.167
13	Maharashtra	984.50	83.80	339.33	1078.78	2486.41	258.16	2744.57
14	Mizoram	0.72	0.67	0.89	1.3	3.58	0	3.58
15	Nagaland	3.82	1.6	2.14	6.42	13.98	0	13.98
16	Orissa	152.38	39.02	33	55	331.94	13	344.94
17	Punjab	0	0	1.7	0	1.7	0	1.7
18	Pondicherry	10.34	77.701	67.51	315.735	471.286	1213.395	1684.681
19	Rajasthan	47.413	0	58.307	196.583	302.303	0	302.303
20	Tamil nadu	135.179	1000.125	330.111	2001.551	3466.966	7250.881	10717.847
21	Tripura	6.325	0	1.62	6.325	14.27	0	14.27
22	Uttar Pradesh	95.414	5.876	16.554	132.213	250.057	4.211	254.268
23	West Bengal	223.43	135.46	181.13	162.72	922.34	0	922.34
	Total	3360.854	2944.553	2825.893	10675.93	20111.05	18821.639	38932.689

* Others includes compost enriches (Trichoderma, Paceliomyces etc), PGPRs, BGA and Azolla
Source: NCOF, Annual Report, 2007-08

The total production of bio-fertilizer was the highest in case of Tamil Nadu when compared to all other states. The next highest production was observed in Karnataka followed by Andhra Pradesh and Kerala. All four south states accounted for almost 73 per cent of total country's production. The results clearly indicate that the awareness and usage of bio-fertilizers was higher in south zone farmers than any other zone. Among different types of bio-fertilizers, the share of PSB in the total production was higher. The production of Azotobacter was high in case of

Maharashtra where as the manufacturing of Azospirillum was high in Tamil Nadu. The demand for Rhizobium as well as PSB was higher in Andhra Pradesh.

Status of bio-pesticides production

The status of bio-pesticide production in India is still in infant stage. Most of organic farmers are using botanical extracts like neem oil/ leaves, calotropis, green chillies, garlic etc for controlling the pests and diseases. Cow urine and fermented curd water are the other substances using with traditional knowledge. Application of bio-pesticides such as Trichoderma, Pseudomonas, Beauvaria and Verticillium are limited. Farmers are either dependent on Agricultural Universities /research stations or private companies for bio-pesticides. The database about these organic input production is not available or yet to be organized. Very few private companies have started commercial production of bio-pesticides in limited scale. But, their production statistics is not publicly available.

Overall, the scenario of organic input production in India is slowly gaining momentum with the increased awareness of the farmers. Role of government plays an important role for further expansion of organic farming in India. Establishment of organized input market channels, encouragement of organic input usage by subsidization and conduct of more awareness/training programs about them would enhance the demand for organic input production in India.

****

Chapter IV

Productivity and Efficiency of Organic input units in India

The present chapter highlights the productivity and efficiency of organic input (mainly vermi-hatchery) units sanctioned under NPOF scheme. This chapter begins with description of analytical framework, brief review of literature, specification of model, sampling strategy and finally ends with empirical results. It also covers the various issues like impact of subsidy on efficiency, factors influencing efficiency, constraints in establishment of organic inputs units and suggestions for promoting organic inputs.

4.1 Analytical framework

Productivity growth and the use of additional inputs are the two major forces behind increased agricultural production. Productivity has two major components: a) technical change, and b) technical efficiency (Good *et al*., 1993). Efficiency is a very important factor of productivity growth especially in developing agricultural economies, where resources are scarce and opportunities for developing and adopting better technologies have lately and dwindling. Such economies can benefit a great deal from inefficiency studies which show that it is still possible to increase production and productivity by improving efficiency, a usually neglected source of productivity, without increasing the resource base or developing new technologies. Estimates of efficiency can also help to decide whether to improve efficiency or to develop new technologies to raise productivity (Sharma and Sharma, 2002).

The two concepts commonly used to characterize a firm's resource utilization performance are (1) productivity, and (2) efficiency. These two concepts are often treated as equivalent in the sense that if firm 'A' is more productive than firm 'B', then it is generally believed that firm 'A' must also be more efficient. But, this is not always true. Although closely related, they are fundamentally different concepts. Productivity is a descriptive measure of performance and efficiency, on the other hand, is a normative measure (Subhash, 2004).

Measuring productivity is quite simple when only a single output is produced with a single input. In this case, output per unit of input is a comprehensive measure of the level of productivity and it can be used in comparing the performance firms or industries. However, it is a little bit more complex when multiple outputs are produced using multiple inputs. In this case, productivity is often measured using partial productivity measures such as output per worker or per hour worked or output per hectare. Though commonly used, partial productivity measures are of limited use and can potentially mislead and misrepresent the performance of a firm. So, productivity is essentially a level concept and measures of productivity can be used in comparing performance of firms at a given point of time. In contrast, productivity change refers to movements in productivity performance of a firm or an industry over time (Coelli *et al*., 2005).

Efficiency of firm is measured in terms of its relative performance-that is, efficiency of a firm relative to the efficiencies of firms in a sample. A formal econometric approach for estimating relative efficiency is with reference to the “best practice frontier”. Best practice frontier, a term originally coined by Farrell (1957) denotes maximum output that can be obtained with a given set of input quantities for a given set of firms in a sample. He also proposed that the efficiency of a firm consists of two components: technical efficiency, which reflects the ability of a firm to obtain maximum output from a given set of inputs, and allocative efficiency, which reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology. These two measures are then combined to provide a measure of total economic efficiency. The output and input perspective will coincide when measuring technical efficiency under Constant-Return-to-Scale (CRS). The allocative and economic efficiency measures however are completely different in nature and are not likely to coincide for other reasons than by chance. Further more, the observations of Farrell input-and output-orientated technical efficiency measures are equivalent to the input output distance functions, discussed in Shephard (1970) and Fare and Primont (1995).

So far, we have discussed the efficiency of operations of a firm with respect to the production technology frontier at a given level of input and output prices. It is possible that a firm is both technically and allocatively efficient but the scale of operation of the firm may not be optimal. Suppose the firm is using a Variable-Return-to-Scale (VRS) technology, then the firm involved may be too small in its scale of operations, which might fall within the Increasing-Return-to-Scale (IRS) part of the production function. Similarly, a firm may be too large and it may operate within the Decreasing-Returns-to-Scale (DRS) part of the production function. In both of these cases, efficiency of the firms might be improved by changing their scale of operations, i.e., to keep the same input mix but change the size of operations. If the underlying production technology is a globally Constant-Returns-to-Scale (CRS) technology then the firm is automatically scale efficient. Fare, Grosskopf and Roos (1998) presented a definition of scale efficiency and use it in deriving a decomposition of productivity change over time. Balk (2001) provided a formal framework to define scale efficiency and to study the role of scale efficiency in productivity change. Balk then compared and evaluated some of the earlier attempts in the literature (Fare *et al*, 1994; Ray and Desli, 1997; Grifell-Tatje and Lovell, 1999; Wheelock and Wilson, 1999; and Zofio and Lovell, 1999) to decompose productivity change into efficiency change, technical change and scale change.

Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) techniques are commonly used tools to measure firm/farm level inefficiencies. Techniques like index number methods, which implicitly assume that all firms are fully efficient. Now, we relax this assumption and used to estimate frontier functions and measure the efficiencies of firms relative to these estimated frontiers. Frontiers have been estimated using many different methods over the past 40 years. Lovell (1993) provided an excellent introduction to this literature. DEA which involves mathematical (non-parametric) programming where as SFA uses econometric (parametric) methods for measuring firm level efficiencies.

4.2 Brief review of literature

4.2.1 Measurement of firm efficiency and its determinants

Parameswaran M. (2002) analyzed the performance of the manufacturing firms in some selected industries in terms of their technical efficiency against the background of the industrial and trade policy reforms introduced in India since 1991. Stochastic frontier production function and associated inefficiency model were used to measure time varying firm specific technical efficiency. He defined technical change as the shift of the best practice production frontier and technical inefficiency change as the movement within the best practice technology. The results showed that all the industries considered registered a higher rate of technical progress in the post reform period along with a decline in the level of technical efficiency. The effect of change in the policy environment on technical efficiency varies among industries. The study also found that firms' involvement in the international trade through export and import of raw materials and technology has a positive effect on technical efficiency.

Admassie A. and Matambalya F.A.S.T (2002) examined the efficiency levels of SMEs (Small and Medium scale Enterprises) in order to formulate appropriate policies for their development. In this study, the level of technical efficiency of SMEs in Tanzania has been examined using a Cobb-Douglas stochastic frontier production function. The findings indicated that high levels of technical inefficiency, which reduce their potential output levels significantly, characterize the Tanzanian SMEs. Assisting those firms to improve their technical efficiency through adequate supply of inputs, markets, and credit facilities, and undertaking extensive infrastructural development and training could be some important measures.

Jun-Yen L. (2005) has applied stochastic frontier analysis (SFA) as well as data envelope analysis (DEA) for measuring and comparing the technical efficiency scores for 79 forest and paper companies. For recognizing the environmental effects on the DEA technical efficiency scores, two-stage DEA was also applied in order to compare any differences in the rank order. The average technical efficiency scores were 0.788 and 0.706 by SFA and DEA, respectively. The highest average efficiency scores, using these two methods were 0.884 and 0.919 observed in Japan, respectively. Moreover, the lowest average efficiency scores were 0.608 and 0.396 found in Latin America. Although slight differences exist in the scores obtained from these two methods, the highest and lowest relative efficiency ranking for forest and paper companies remain the same. The tests of the rank order correlation were all statistically significant among the SFA, the DEA, and the two-stage DEA methods. The results suggested that policy makers and analysts could be ease when employing these methods to identify the relative efficiency scores for forest and paper companies.

Bhandari A.K and Subhash C.R (2007) analyzed the technical efficiency in the Indian Textile Industry using non-parametric analysis of firm-level data. The Indian textiles industry was at the crossroads with the phasing out of quota regime that prevailed under the Multi-Fiber Agreement (MFA) until the end of 2004. In the face of a full integration of the textiles sector in the WTO, maintaining and enhancing productive efficiency was a precondition for competitiveness of the Indian firms in the new liberalized world market. In this paper, they obtained the data from the Annual Survey of Industries for a number of years to measure the levels of technical efficiency in the Indian textiles industry. They used both a grand frontier applicable to all firms and a group frontier specific to firms from any individual state, ownership, or organization type in order to evaluate their efficiencies. This has permitted them to separately identify how locational, proprietary, and organizational characteristics of a firm affect their performances.

Milana C. *et al* (2008) estimated the firm-level analysis of the multifactor productivity that has been recently observed in Italy. DEA technique was applied to the firm-level data collected within the annual surveys on the economic accounts of enterprises carried out by the Italian National Statistical Institute (ISTAT). The MFP changes occurred during the period 1998-2004 have been measured for 25 industries and have been decomposed into technological change (shift in the production frontier) and change in relative technical inefficiency (due to modifications in the distance of the single firms from the frontier). The outcome of the results highlighted stagnation in Italian MFP trends; in particular, a decrease in MFP was registered for many economic sectors.

Graner M. and Isaksson A. (2009) investigated the link between firm efficiency and exports from Kenyan manufacturing units. The results showed that exporters were more efficient than non-exporters, and relatively efficient firms self-select into exporting. An important new finding was that only for export markets outside Africa, firms must be efficient prior to entry; for those exporting within Africa this requirement seems less binding. Furthermore, the probability to export to other African countries increases if production was intense in physical and human capital, while for export activities outside Africa firm size is more important. Contrary to many other studies, it was also found evidence that export participation yields learning-effects. When testing the hypothesis that the main source of learning-effects was trade with developed countries (South-North), as opposed to trade with other developing countries (South-South). Yet, another finding was that learning-effects obtained only in South-South trade. So, the study concluded that controlling the destination of exports importantly improves the understanding of the relationship between firm efficiency and exports.

Kinda T. *et al* (2009) investigated the relationship between firm-level technical efficiency and the investment climate for 22 developing economies and eight manufacturing industries based on the World Bank Investment Climate Assessment Surveys. The results showed that, on average, enterprises in the Middle East and North Africa have performed poorly compared with other countries in the sample. The exception was Morocco, whose various measures of firm-level productivity rank close to the ones of the most productive economies. The analysis also revealed that the competitiveness of countries in the region has been handicapped by high unit labor cost, compared with main competitors like China and India. The empirical results proved that the investment climate matters for firms' productive performance. Depending on the industry, the efficiency was influenced by various parameters like quality of infrastructure, the experience and education, level of the labor force, the cost of and access to financing, as well as different dimensions of the government-business relation. The results also exhibited that some industries, exposed high to international competition, were more sensitive to investment climate deficiencies. Finally, these findings bear very clear policy implications on increasing firms' size and improving the investment climate (in particular of small and medium firms and industries more exposed to international competition) could constitute a powerful means of industrial development and competitiveness, in the Middle East and North Africa region in particular.

Aggrey N. *et al* (2010) established the relationship between firm size and technical efficiency in East African manufacturing firms. This study used a two-step methodology to examine the relationships. In the first step, technical efficiency measures were calculated using DEA approach. Secondly, by using GLS technique, technical efficiency equation was fitted to investigate the relationship between them. Contrary to our expectation, the results showed a negative association between firm size and technical efficiency in both Ugandan and Tanzanian manufacturing firms. The existence of a positive association between size squared and technical efficiency was observed. The negative association between them indicated an inverted U-relationship in those countries.

Cechura L. (2010) estimated the technical efficiency in Czech agriculture with respect to firm heterogeneity. Choice of a proper model specification, distinguishing between technical inefficiency and firm heterogeneity and level of technical efficiency were the two major questions analyzed in this paper. The results showed that only those model specifications allowing for the capture of time-invariant firm heterogeneity might provide consistent estimates of technical efficiency. Specifically, the Random Parameters family of models was a superior specification for the estimation of technical efficiency in the analysis. Moreover, technical inefficiency was proved to be a significant phenomenon in Czech agriculture. The average level of technical efficiency was around 90% for agricultural companies.

Mazumder R. and Adhikary M. (2010) have measured firm-specific time invariant technical efficiency in the Indian automobile industry during 2004–06 using a suitably constructed stochastic production frontier. The one-sided inefficiency random variable was assumed to be truncated normal with a variable mode which was non-neutral with respect to some selected firm-specific factors, capable of explaining inter-firm variations in the level of technical inefficiency. It was found that age of the firm since inception and level of technical efficiency were inversely associated. However, the market share of the firm and the degree of automation were found to be positively associated with firm level technical efficiency. Statistical tests further revealed that the underlying technology in the automobile industry in India was linear homogeneous.

4.2.2 Impact of subsidy on efficiency

Emvalomatis *et al*., (2008) examined the relationships between subsidies on production and technical efficiency in agriculture in case of cotton producers in Greece. Subsidies on production have been criticized for protecting producers from competition, and thus removing an incentive for efficient use of the resources. The dataset used for this purpose was from the Farm Accountancy Data Network (FADN) and covers the period 1996 to 2000. The stochastic frontier approach, linear fixed effects and Monte Carlo maximum likelihood techniques were used for the estimation of efficiency. The results indicated that compensatory area payments reduce the efficiency scores of the producers by diverting resources from products for which the subsidy was based on the area planted to the production of cotton and its volume of output. Decoupled aid can be viewed by farmers as an alternative source of income additional to the sales of cotton. Although the land and resources which were allocated for production cereals on the contrary to cash crops. Finally, they concluded that ignoring the presence of unobserved heterogeneity would overstate the levels of inefficiency.

Lakner (2009) investigated the efficiency of organic milk farms in Germany and the role of subsidies and of regional factors based on data from 1994-95 to 2005-06. Five inputs and one output were analyzed by using a stochastic frontier production function, allowing for heteroscedasticity and technical effects. The selection of determinants of technical efficiency included five groups of indicators (management capacity, farm structure, institutional choices, policy support and regional variables). The analysis was focused on the impacts of farm support of organic farms and of regional factors that can influence technical efficiency. Results concluded that the farms in conversion showed lower TE scores than regular organic farms. There were regional differences in the technical efficiency among farms. When compared to Southern region, the milk-farms in West and Northern region were more efficient. There was not significant difference between Eastern and Southern region farms. The study also concluded that the farms who received agri-environmental payments and investment aid showed lower efficiency scores.

Data Envelopment Analysis Vs Stochastic Frontier Approach

Seiford and Thrall (1990) examined the recent developments in DEA: The mathematical programming approach to frontier analysis. They concluded that the rapid growth and widespread acceptance of the methodology of DEA was testimony to its strength and applicability. According to them, the other advantages are: DEA analyzes each DMU separately; it measures relative efficiency with respect to the entire set being evaluated. A variable that is neither an economic resource nor a product but is an attribute of the environment or of the production process can be easily included in a DEA-based production model. Finally, they concluded that DEA uses standard techniques of linear programming which benefits computation; dual variables, clear interpretations etc.

Battese (1992) made an attempt to review the applications of Frontier production functions and measure of technical efficiency in the empirical applications of agricultural economies in the developing and developed countries. He opined that frontier production functions have permitted sophisticated analyses of technical efficiency in wide range of studies. But, some times, these studies opened to criticism for not including some relevant inputs or firm-specific variables or for not involving more appropriate functional forms. He also suggested that the use of frontier production functions for the prediction of the technical efficiencies of farmers involves several problems which require further research. The precision of predictors for individual technical efficiencies was also an area which required careful research.

Heshmati and Kumbhakar (1994) examined the technical efficiency of four panels of Swedish dairy farms, during the period 1976-1988, excluding 1985, using the stochastic frontier approach and a translog production function. They found that the mean technical efficiency indices were located between 0.81 and 0.83 for all four panels. Jonasson (1996) measured various output efficiencies of a sample of Swedish farms during 1989-1991, using DEA. He found that the average technical and allocative output efficiencies were 0.95 and 0.92 respectively. A possible reason for the great difference between the two studies in Sweden is that Jonasson did not aggregate output in DEA. Adding an extra output or input in DEA will never cause a reduction of the efficiency scores and a greater number of outputs and inputs compared to the total number of observations will always cause greater efficiency scores (Coelli *et al*, 2002). Thus, the difference is much likely to depend on the difference in the methods.

Coelli (1995) summarized different studies on recent developments in frontier modeling and efficiency measurement. He surveyed the potential applicability of these methods in agricultural economics and compared the two primary methods (i.e., SFA and DEA). He concluded in his study that the best method one should use is depends upon its application. If one is using farm level data where measurement error, missing variables, weather etc are likely play a significant role, he recommended SFA for use in most agricultural applications. Further more, in instances where production involves more than one product, and construction of an aggregate measure of output is difficult, DEA may be more attractive (poultry, dairy, pig farming etc). All forms of empirical modeling, a frontier study was suffered from a variety of possible pitfalls, such as: poorly measured inputs data, the unaccounted environmental factors, improper soil quality or topography measurement influenced technical efficiency measurement.

Johansson H (2005) conducted a study to assess technical, allocative and economic efficiency on Swedish Dairy farms. He used both Data Envelopment Analysis (DEA) and Stochastic Frontier Approach (SFA) for this purpose and results were compared. When applying SFA, the mean technical, allocative and economic efficiency indices for the entire period were 0.55, 0.75 and 0.41 respectively. However, when applying the DEA, they were 0.74, 0.61 and 0.45 respectively. Thus, the mean technical efficiency index is much higher under DEA than under SFA. Following the example of Sharma (1999) a paried t-test was conducted which shows that the measures of technical efficiency were significantly higher under the DEA approach. This is somewhat unexpected since DEA is deterministic and reports all deviations from the frontier as inefficiency. Thus, the measures are expected to be higher under SFA. As all three indices are measured against the same frontier, the measure of economic efficiency is consequently higher under the DEA approach. This was also confirmed by the paired t-test. However, the t-test showed that the measures of allocative efficiency were significantly higher under SFA. This is most likely a consequence of the low technical efficiency indices. A Kruskal-Wallis test was conducted to test for differences in efficiency rankings between SFA and DEA, which showed no evidence for different rankings. He concluded that when the entire dairy farm is studied, the DEA is more appropriate to use since it does not require any particular parametric form to be chosen. He also concluded that the Cobb-Douglas production function is not a satisfactory choice of frontier function when the farm is studied from the integrated perspective. However, to derive the allocative and economic efficiency of the farms, it was necessary to assume a self dual production function (i.e. Cobb-

Douglas). He also found that the influence of size on the efficiency scores of a firm indicated a positive relationship between them.

Obviously, choosing between parametric and nonparametric methods is a delicate matter and some studies comparing the results of two approaches have been done. An example outside the agricultural sector is Coelli and Perelman (1999) who compared technical efficiency scores on a sample of European railways. They found that the choice of method should not have much influence on the results. Resti (1997) compared cost efficiency scores on a sample of Italian banks. She found that there was not much difference between the two methods. In agriculture, an example is Iráizoz *et al* (2003) who compared technical efficiency results on a sample of Spanish vegetable producers and found correlation between the parametric and nonparametric approach. Sharma *et al* (1999) who compared the decomposition of economic efficiency into its technical and allocative parts under parametric and nonparametric approaches on swine producers in Hawaii. In their study the SFA technical efficiency was measured against a Cobb-Douglas production function. They found that, on average, the estimated technical and economic efficiencies were significantly higher in the SFA compared to the DEA under the assumption of constant returns to scale (CRS). Under the assumption of variable returns to scale (VRS) however, the measures were quite similar. Allocative efficiency was found to be generally higher in DEA. The efficiency ranking of the farmers in the sample was positively correlated, indicating that the two approaches assess relative efficiency to the same farms. An analogy to the studies outside the agricultural sector is not possible for the same reason, but also because agriculture is likely to differ much from other sectors in the economy. One reason is the strong connection to and dependence on the farm family.

Many studies have showed that the results of efficiency are sensitive to the method selected for estimate the efficiency scores. The choice of method to use is in no way obvious, but has to be decided in every case. The quality of the data, the appropriateness of various functional forms, and the possibility of making behavioural assumptions will heavily influence the relative appropriateness of DEA and SFA. For example, the DEA approach, compared to the SFA doesn’t require any specific functional form to be selected, neither are any behavioural assumptions needed as long as allocative efficiency is not considered. However, DEA is a deterministic approach, meaning that it doesn't account for noise in the data. All deviations from the frontier will thus be accounted for as inefficiencies. Therefore the DEA efficiency scores are likely to be sensitive to measurements errors and random errors. The SFA on the other hand accounts for random errors and has the advantage of making inference possible. (Coelli *et al*, 2002). However, SFA is sensitive to the choice of functional form.

In summary, the main conclusion is that none of the proposed methods of measuring efficiency relative to an estimated frontier is perfect. However, they all provide substantially better measures of efficiency than simple partial measures (Coelli, 1995). Further, detailed comprehensive reviews of the two approaches were provided by Lovell (1993), Ali and Seiford (1993), Coelli (1995), Bauer (1990), Fried *et al*. (1993), Bravo-Ureta and Pinheiro (1993). In general, a large number of studies on efficiency measurements argue that a researcher can safely choose any of the methods since there are no significant differences between the estimated results (Coelli, Sandura and Colin, 2002). Hence, this study followed DEA technique for analyzing the efficiency of organic input units in India. The dual output (vermi-compost and worms) nature of organic input units is also one of the reasons for the selection of DEA technique compared to SFA.

4.3 Specification of model (*Data Envelopment Analysis)*

DEA involves the use of linear programming methods to construct a non-parametric piecewise surface (or frontier) over the data, so as to be able to calculate efficiencies relative to this surface. More detailed reviews of the DEA methodology were also presented by Seiford and Thrall (1990), Lovell (1993), Ali and Seiford (1993), Lovell (1994), Charnes et al (1995) and Seiford (1996).

Charnes, Cooper and Rhodes (CCR) (1978) introduced a mathematical programming approach, Data Envelopment Analysis (DEA), to calculate the relative efficiencies of decision-making units (DMUs) based on constant returns to scale (CRS) assumption. CCR used the optimization method of mathematical programming to generalize the Farrell (1957) single-output/input technical efficiency measure to the multiple-output/input case by constructing a single "virtual" output to single "virtual" input relative efficiency measure. Subsequently, numerous papers have considered alternative sets of assumptions, such as Banker, Charnes and Cooper (BCC) (1984) who proposed a variable returns to scale (VRS) model. It distinguishes between technical and scale inefficiencies (see Fare et al., 1994 also). Later Fare, Grosskopf, Norris and Zhang (1994) applied Malmquist DEA methods to panel data to calculate indices of total factor productivity (TFP) change, technological change; technical efficiency change and scale efficiency change. DEA is a system approach widely used in management science and economics, in which the relationships between all inputs and outputs are taken into account simultaneously (Yusuf and Malomo, 2007). The method enables to find out the relative efficiency of a farm and to examine its position in relation to the optimal situation. The strength of DEA is that it does not require any assumptions about the functional farm.

Assume there is a data on K inputs and M outputs on each of N firms or DMU's. For the ith DMU these are represented by the vectors x_i and y_i, respectively. The K x N input matrix, X, and the M x N output matrix, Y, represent the data of all N DMU's. The purpose of the DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier. Given the CRS assumption, this can be represented as:

The best way to introduce DEA is via the ratio form. For each DMU we would like to obtain a measure of the ratio of all outputs over all inputs, such as $u'y_i / v'x_i$, where u is an M x 1 vector of output weights and v is a K x 1 vector of input weights. To select optimal weights we specify the mathematical programming problem:

$$\begin{aligned} &\text{Max}_{u,\,v}\ (u'y_i / v'x_i) \\ &\text{st} \quad u'y_j / v'x_j \le 1, \quad j = 1, 2 \ldots N, \\ &u, v \ge 0 \qquad\qquad (1) \end{aligned}$$

This involves finding values for u and v, such that the efficiency measure of the ith DMU is maximized, subject to the constraint that all efficiency measures must be less than or equal to one. One problem with this particular ratio formulation is that it has an infinite number of solutions. To avoid this one can impose the constraint $v'x_i = 1$, which provides:

$$\begin{aligned}
&\text{Max}_{u,\,v}\ (\mu' y_i),\\
&\text{st} \quad \gamma' x_i = 1,\\
&\mu' y_j - \gamma' x_j \le 0,\ j = 1, 2 \ldots N,\\
&\mu,\ \gamma \ge 0 \qquad\qquad (2)
\end{aligned}$$

Where the notation change from u and v to μ and γ reflects the transformation, this form is known as the multiplier form of the linear programming problem.

Using the duality in linear programming, one can derive an equivalent envelopment form of this problem:

$$\begin{aligned}
&\text{Min}_{\theta,\lambda}\ \theta,\\
&\text{Subject to} \quad -y_i + Y\lambda \ge 0,\\
&\theta x_i - X\lambda \ge 0,\\
&\lambda \ge 0 \qquad\qquad (3)
\end{aligned}$$

Where θ is a scalar and λ is N x 1 vector of constants. This envelopment form involves fewer constraints than the multiplier form (K+M < N+1), and hence is generally the preferred form to solve. The value of θ obtained will be the efficiency score for the ith DMU. It will satisfy $\theta \le 1$, with a value of 1 indicating a point on the frontier and hence a technically efficient DMU, according to the Farrell (1957) definition. Note that the linear programming problem must be solved N times, once for each DMU in the sample. A value of θ is then obtained from each DMU.

The CRS assumption is only appropriate when all DMU's are operating at an optimal scale. Imperfect competition, constraints on finance, etc, may cause a DMU to be not operating at optimal scale. The use of the CRS specification when not all DMU's are operating at the optimal scale will result in measures of TE which are confounded by Scale efficiencies (SE). The use of the VRS specification will permit the calculation of TE devoid of these SE effects. The CRS linear programming can be easily modified to account for VRS by adding the convexity constraint: $N1'\lambda = 1$ to (3) to provide:

$\text{Min}_{\theta,\lambda}\ \theta,$

Subject to $\quad -y_i + Y\lambda \geq 0,$

$\theta x_i - X\lambda \geq 0,$

$N1'\lambda = 1$

$\lambda \geq 0 \qquad (4)$

Where N1 is an N x 1 vector of ones, this approach forms a convex hull of intersecting planes which envelope the data points more tightly than the CRS conical hull and thus provides technical efficiency scores which are greater than or equal to those obtained using the CRS model.

Many studies have decomposed the TE scores obtained from a CRS DEA into two components, one due to scale inefficiency and one due to "pure" technical efficiency. If there is a difference in the two TE scores for a particular DMU, then this indicates that the DMU has scale inefficiency, and that the scale inefficiency can be calculated from the differences between the VRS TE score and the CRS TE score.

CRS TE = VRS TE x SE (5)

If one has price information and is willing to consider a behavioural objective, such as cost minimization and revenue maximization, then one can measure both technical and allocative efficiencies. The cost minimization vector of input quantities given the input prices is determined using:

$\text{Min}_{\lambda, xi^*}\ w_i' xi^*,$

Subject to $\quad -yi + Y\lambda \geq 0,$

$xi^* - X\lambda \geq 0,$

$N1'\lambda = 1$

$\lambda \geq 0, \qquad (6)$

Where w_i is a vector of input prices for the i-th DMU and xi* (which is calculated by the LP) is the cost-minimizing vector of input quantities for the i-th DMU, given the input prices w_i and the output levels y_i. The total cost efficiency (CE) or economic efficiency of the ith DMU would be calculated as

$CE = w_i' xi^* / w_i' xi$

That is, the ratio of minimum cost to observed cost. One can then calculate the allocative efficiency residually as AE = CE / TE

In many studies the analysts have tended to select input-oriented models because many DMU’s have particular orders to fill (ex. production units) and hence the input quantities appear to be the primary decision variables, this argument may not be as strong in all industries. In some industries the DMUs may be given a fixed quantity of resources and asked to produce as much output as possible. In this case an output orientation would be more appropriate. Essentially one should select an orientation according to which quantities (inputs or outputs) the managers have most control over. Further, Coelli and Perelman (1996) concluded in their study that the choice of orientation will have only minor influences upon the score obtained. Hence, this study adopted only input orientation rather than output orientation because the sample related to organic production units where output determines by inputs.

Each observation included two outputs i.e., average vermi-compost production (Y1) per unit per annum in tons and sale of worms (Y2) per unit per annum in kg. In the input category, four variables were included. They were raw materials qty (X1) mainly dung in tons per annum, qty of worms used per annum (X2) in kg, units of labor used (both hired and own) per annum (X3) and no.of months electricity (X4) used per annum. The unit prices of four input variables were also used in the calculation of cost-DEA functions. Under this approach, both CRS and VRS models were applied to data with input orientation. The DEA models were estimated using programme DEAP 2.0 (Coelli, 1996).

4.4 Sampling strategy

Keeping the issues covered in the earlier sections, the study considered both organic input production units (sanctioned under NPOF scheme only) as well as organic input user i.e. organic farmers for the sample. The present study used the following steps for identification of the sample:

Step 1: The selection of sample organic input units for the study was purposively chosen from four states, namely; Punjab, Uttar Pradesh, Gujarat and Maharashtra.

One of the reasons for choosing these four states was to see the comparison in efficiency of organic input units between the Northern states (where irrigation and fertilization application is default in states like Punjab and U.P) and Western states (where irrigation and fertilizer application is optional in states like Maharashra and Gujarat) of India. Moreover, study has also a limitation in choosing the sample only from vermi-hatchery units rather than from other two types of input units (bio-fertilizers and fruit and vegetable waste units). This is because of the highly scattered distribution of three type units across different states of India. However, these four states accounted for nearly 60 per cent of total sanctioned vermi-hatchery units in India (see table 3.3). The details of sample selected for the study is presented in table 4.1.

The two sanctioned fruit and vegetable waste units present in Uttar Pradesh and Gujarat states were covered in the study. There are no fruit and vegetable waste units sanctioned in Punjab and Maharashtra states. Similarly, in case of bio-fertilizer units, one unit from each state was selected randomly from the population. But, there is no bio-fertilizer unit sanctioned in Uttar Pradesh state. So, the total bio-fertilizer units included in the sample was three out of the total population of ten units in four states. Fourth bio-fertilizer unit was selected for the study from the two Maharashtra units subsidized by NCDC (see table 3.4). But, in case of vermi-culture hatchery units, a total sample of 40 units were chosen in clusters under four states for the study. The criterion used for selection of sample units from each state was on their respective weights in the population. Due to their extremely scattered nature in each state, vermi-hatchery sample units were chosen in two to three groups/clusters in order to minimize the travel costs and time. A well structured and pre-tested questionnaire was administered to extract some common quantitative parameters of each type of unit; with utmost emphasis was placed on qualitative case analysis through interaction with the organic input units.

Apart from the quantitative analysis of primary data for efficiency measurement, qualitative analysis of efficiency was done by in-depth case analysis of selected units. Two fruit and vegetable waste units and four bio-fertilizer units (3 from NABARD and one from NCDC sample) were covered comprehensively as cases. Similarly, two vermi-hatchery units were also highlighted as cases to complement the quantitative results obtained. Finally, a sum of eight cases was described separately in this chapter 5.

Table 4.1 Details of sample units selected for the study

Type of input unit	Punjab	Uttar Pradesh	Gujarat	Maharashtra	Total sample for study
Fruit and vegetable waste units	-	1 (1)	1 (1)	-	2 (2)
Bio-fertilizer units	1 (1)	-	1 (3)	1 (6)	3 + 1 NCDC unit (12)
Vermiculture hatchery units	6 (42)	17 (115)	13 (86)	4 (29)	40 (272)

Note: Figures in the parentheses indicates total no.of units sanctioned in that state

Step 2: A random sample of 15 organic farmers per each state (organic input users) were drawn from study area to canvass a structured questionnaire to extract constraints in procuring and usage of organic inputs etc. Thus, the study covered 60 organic farmers from four states. Another random sample of 15 conventional farmers (in-organic input users) was also selected to compare the crop economics and productivity of crops with organic cultivation in the respective study area.

4.5 Empirical results

The empirical results highlighted in this section were mainly pertains to vermi-hatchery units sanctioned under NPOF scheme. The details of fruit and vegetable waste units and bio-fertilizer units were represented as detailed cases in chapter 5. All the sample vermi-hatchery units were contacted with advance intimation to promoters and visited them along with respective officials from financial bank. The results of primary data collected were organized in following sections:

4.5.1 Sample distribution

The details of sample districts, blocks/talukas and villages chosen for the study are presented in table 4.2. A total of 40 sample units were selected from Gujarat, Maharashtra, Punjab and Uttar Pradesh states purposively based on their weights in the total units sanctioned in these four states. A sample of 13 units from Gujarat and 4 units from Maharashtra were chosen randomly which accounted for 15.1 and 13.8

per cent to the total number of units sanctioned in their states respectively. Similarly, six units from Punjab and 17 units from Uttar Pradesh were identified for the study. They accounted for 14.3 and 14.8 per cent of the total units sanctioned in these states. In Gujarat, three sample districts namely Baroda, Ghandhinagar and Sabarkanta were selected because location of units in clusters. Among these districts, a large cluster of 8 units was present in Baroda district followed by Ghandhinagar (4) and Sabarkanta (1). The selected 13 sample units were in turn again located in 4 talukas/blocks and eight villages of the state. Savli taluka was having the largest cluster of eight sample units. Similarly, among all villages, Subhaelav was having maximum number of five sample units.

Table 4.2 Distribution of the sample

Strata	Gujarat	Maharashtra	Punjab	Uttar Pradesh
Sample*	13 (15.1)	4 (13.8)	6 (14.3)	17 (14.8)
Sample Districts^	Baroda (8) Ghandhinagar (4) Sabarkanta (1)	Ahmednagar (3) Sangli (1)	Ludhiana (4) Fatehgarh Sahib(2)	Baghpath (11) Muzaffarnagar (4) Aligarh (2)
Sample Talukas/ Blocks^	Savli (8) Dehgam (3) Prantij (1) Ghandhinagar (1)	Sangamner (1) Khanapur (1) Newasa (2)	Machhiwara (4) Basipathana (2)	Chamrawal (1) Faizullapur (1) Hisarda (1) Kekhada (2) Singhavali (1) Sadikapur (2) Baghpat (3) Titawi (1) Baghra (3) Gaumat (2)
Sample Villages^	Subhaelav (5) Gothada (2) Savli (1) Vasanachaudary (1) Patnakuva (1) Ghdakan (1) Palaiya (1) Chandrala (1)	Dadhkurd (1) Renavi (1) Rastapur (2)	Rajgarh (2) Sherpur (2) Sirkapra (2)	Chamrawal (1) Faizullapur (1) Hisarda (1) Badagon (1) Khatta prahladpur (1) Singhavali (1) Sadikapur (1) Surajpur Makhanwa (1) Mitili (1) Sisana (1) Dola (1) Lakhan (1) Naseerpur (1) Ladwa (1) Naseerpur (1) Rajpur (1) Sujanpur (1)

Note: * - Figures in the parenthesis indicate percentage to total units sanctioned in that state
^ - Figures in the parenthesis indicate no. of units chosen

In case of Maharashtra, two districts were chosen for the study. They are namely Ahmednagar and Sangli districts. A sample of three out of four selected units were situated at Ahmednagar where as Sangli was having one unit. Overall, the sample units were identified in three talukas/blocks and three villages of the state. Taluka Newasa and Rastapur village both were having two units each in them.

Sample of six units in Punjab was dispersed in two districts namely Ludhiana and Fatehgarh Sahib. Ludhiana was having more number (4) of units in Machhiwara block when compared with Fatehgarh Sahib where two units were present in Basipathana block. The six units were equally distributed among three villages i.e., Rajgarh, Sherpur and Sirkapra of the state.

Baghpath, Muzaffarnagar and Aligarh were the three districts selected under Uttar Pradesh state for the study. A lion share of 65 per cent units was located in Baghpath followed by Muzaffarnagar (23.5%) and Aligarh (11.5%) district. The sample units in the state were much scattered in around 10 talukas/blocks. However, all the selected 17 sample units were also identified from 17 villages of the state.

4.5.2 Socio-economic characteristics of sample

The socio-economic profile of sample beneficiaries is presented in table 4.3. Overall, only three beneficiaries (7.5 per cent) out of 40 were having vermi-hatchery as their primary occupation. All the three beneficiaries belonged to Uttar Pradesh state. A major share (62.5 per cent) of beneficiaries expressed agriculture as major source of income. The remaining 30 per cent of sample beneficiaries were depended on livestock, business, service etc as the principle income avenues. The percentage dependency on agriculture as main source of income was very high in Gujarat followed by Punjab, U.P and Maharashtra. We can conclude that majority of the beneficiaries were not relying on vermi-hatchery as a major income source.

Only three beneficiaries (7.5 per cent) were expressed vermi-hatchery as their secondary source of income. Nearly, half of the sample (47.5 per cent) was dependent on agriculture and animal husbandry sectors. A sample of 27.5 per cent beneficiaries was earning their secondary incomes through service and business. Seven (17.5 per cent) out of 40 sample beneficiaries were not rely on any economic activity for their secondary occupation. Among different states, the share of dependency on service/business was high in Gujarat followed by Punjab. The results indicate that most of the farmers in the study area are not taking up vermi-hatchery units in a commercial way.

.

On the whole, more than half (55 per cent) of the sample was studied either intermediate or graduation. One-fourth of the beneficiaries were passed out in post-graduation or in doctorate. Only 17.5 per cent of the borrowers were just qualified in tenth class. A lone farmer (2.5 per cent) in the entire sample did not have education. The illiteracy was high (7.6 per cent) in Gujarat when compared to other states. In general, 35 per cent of the sample beneficiaries were members either in formal (village gram panchayat or credit cooperative society or milk cooperative society or cane growers association) or informal bodies (environmental society or educational society). None of the sample borrower from Gujarat state was member in any society. But, their membership was significant in the remaining three states.

Table 4.3 Socio-economic characteristics of the sample (no. of units)

Parameter	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all (n=40)
Primary occupation					
a. Vermi hatchery	0	0	0	3	3
b. Agriculture	10	2	4	9	25
c. Others	3	2	2	5	12
Secondary occupation					
a. Vermi hatchery	0	1	0	2	3
b. Agriculture/ livestock	6	2	2	9	19
c. Service/Business	5	0	2	4	11
d. None	2	1	2	2	7
Educational qualifications					
a. Illiterate	1	0	0	0	1
b. S.S.C	2	0	2	3	7
c. Intermediate/Graduate	9	2	2	9	22
d. Post-graduate/Doctorate	1	2	2	5	10
Other positions (Y/N)					
a. Yes	0	2	2	10	14
b. No	13	2	4	7	26
Average family size (no.)	5.7	4.7	5.3	7.6	6.3
Average no.of family labor work in the unit (no).	0.8	1.7	1.6	2.0	1.5
Average land holding (acres)	19.1	102.0	49.5	9.4	27.8
Livestock (no.)	6.9	102.5	13.3	4.3	16.3

On an average, the size of family was 6.3 per household. The average size of the family was the highest in U.P (7.6) followed by Gujarat, Punjab and Maharashtra. The lowest size of family (4.7) was recorded in Maharashtra state. Overall, the average number of family members participated in vermi-hatchery unit was 1.5 per household. But, their participation rate was the highest in U.P (2.0) followed by Maharashtra, Punjab and Gujarat. The lowest family participation rate was noticed in case of Gujarat (0.8 per household). This also confirms that they were more interested in non-farm activities rather than farm-activities.

The average size of land holding per household was 27.8 acres. This value was much higher in Maharashtra (102 acres) because two landlords who have 200 acres each were established vermi-hatchery units. Among the three remaining states, Punjab was having the highest (49.5 acres) followed by Gujarat and U.P. The mean size of livestock population per household was 16.3. It indicates that each household was having sufficient number of buffaloes for production of vermi-compost. Similarly, the value was very high for Maharashtra (102.5) because two landlords were having 200 animals each in their farms. The lowest number of animals (4.3) per household was observed in U.P state.

4.5.3 Primary details of sample units

The state-wise primary details of the selected units is presented in table 4.4. On whole, only 22 out of 40 units were functioning on the day of visit. The number of non-functioning units were maximum (100 per cent) in case of Gujarat. The main reasons for not functioning are: lack of demand for vermi-compost, neither JMC visit nor subsidy release from NABARD, death of worms in high temps, heavy rains and floods. The percentage of non-functioning units was 25 and 23.5 per cent respectively in case of Maharahstra and U.P states. But, in case of Punjab all six units were functioning well.

Almost all the 40 sample units were completed the establishment of units. None of the sample unit is still under construction process. Nearly 97.5 per cent units have finished their construction with in stipulated period of six months. A lone unit in U.P has crossed its timeline of six months for establishment of unit. The average time taken from sanctioning of the loan to completion of unit was 96 days. The state-wise average time taken was the highest in case of Maharashtra followed by U.P, Punjab and Gujarat. It indicates that most of structures constructed in Gujarat were taken very less time.

Table 4.4 Primary details of sample units (no. of units)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Units functioning on day of visit					
a. Functioning	0	3	6	13	22
b. Not functioning	13	1	0	4	18
Units construction					
a. Completed	13	4	6	17	40
b. Not completed	0	0	0	0	0
Construction completed with in					
a. Stipulated six months time	13	4	6	16	39
b. Not completed	0	0	0	1	1
Average time taken from sanctioning to completion of unit (days)	51	165	54	126	96
Any refund of advance subsidy					
a. Yes	8	0	0	0	8
b. Avg. amount (lakh)	0.50	N.A	N.A	N.A	0.50
Completion certificate given to bank					
a. Yes	12	3	6	17	38
b. No	1	1	0	0	2
Joint Monitoring committee (JMC) visited					
a. Completed	8	3	6	11	28
b. Not completed	5	1	0	6	12
Final subsidy received (Rs.)					
a. Yes	1	3	4	11	19
b. Avg. amount (lakh)	0.81	0.75	0.75	0.75	0.75
Average age of the unit (months)					
a. Less than or equals to 12	4	1	0	2	7
b. Between 13-24	2	0	6	7	15
c. > 24	7	3	0	8	18
Encountered problems in getting subsidy from NABARD					
a. Yes	11	0	2	7	20
b. No	2	4	4	10	20
Any permission/license obtained for marketing					
a. Yes	0	1	0	0	1
b. No	13	3	6	17	39

If the farmer could not able to construction the unit with in stipulated period of six months time or if Joint Monitoring Committee (JMC) visits and feel that the standards are not up the mark of NABARD, then NABARD will recall the advance subsidy amount from the borrower/beneficiary. Overall, 8 units out of 40 sample units repaid their advance subsidy to NABARD because their standards of establishment of units was not up to the mark of NABARD stipulated guidelines. All these repaid units were located in Gujarat state only. The average amount they paid back to NABARD was Rs.50,000 per unit. This concludes that the units constructed in Gujarat were very poor and inefficient when compared to other state units.

When the project is nearing in completion, the promoter will inform the bank by the way of submission of a completion certificate. This will initiate the action for JMC visit. Almost 95.0 per cent of sample promoters have submitted their completion certificates to banks. One each from Gujarat and Maharashtra were not submitted to bank till date. This was due to lack of awareness among promoters as well as bank officials. But, so far NABARD conducted JMC visits only in 70 per cent sample units. Nearly, 30 per cent of sample units were still waiting for JMC visits and final subsidy amounts. This indicates a huge delay in the process of subsidy release. Among the four states, the delays were more pronounced in Gujarat (38%) and U.P (35 %) states. Out of the 28 units (70%) who completed JMC visits, only 19 units (67.8%) have received the final subsidy amounts. The average amount they received was Rs.75,000 per unit. Around 32 per cent of units were still waiting for release of final subsidy amounts by NABARD. This was another bottleneck in the scheme where lot of time was consuming for processing.

On whole, 45 per cent of sample units were established more than two years back. 37.5 per cent of units were belonging to the age range of between 13 and 24 months. Seven units (17.5 per cent) were having less than one year old age. In total, nearly 82.5 per cent of the sample units were established more than one year back. Across different states, units with age more than two years were present more in U.P followed by Gujarat and Maharashtra.

When we asked about their problems in getting the subsidy from NABARD, nearly half of the sample promoters were expressed that they faced problems. The proportion of the promoters faced problems were more in Gujarat (55%) followed by U.P (35%) and Punjab (10%). A lone farmer in the entire sample was succeeded in obtaining the license/certification for marketing his product. Remaining 39 promoters (97.5%) did not have any license or permission for marketing their product. This is another loophole in the scheme that who will certify; how to obtain, what is the cost etc details; many of the promoters were not aware.

4.5.4 Financial details of sample units

The summary of financial information of sample units is presented in table 4.5. On an average, 5.9 lakh per unit was the financial outlay. The outlay was the highest in case of Maharashtra (6.3 lakh). While, this amount was same in case of Gujarat and U.P states (5.9 lakh). But, it was the lowest in case of Punjab state (5.7 lakh). The average promoters' contribution in the total outlay was 1.6 lakh. However, this amount was the highest in Maharasthra followed by Gujarat. The mean bankers' loan amount was 4.3 lakh per unit. The bankers' loan amount was the highest in U.P followed by Punjab states. Nevertheless, the eligible subsidy amount was uniform across states i.e., 1.5 lakh per unit. But, the actual mean subsidy received till date per unit was Rs.0.93 lakh only. There was a huge gap of 0.57 lakh between these two figures. This gap was the highest in case of Gujarat (1.23 lakh) followed by U.P (0.27 lakh) and Punjab (0.25 lakh). The difference was the lowest in Maharashtra (0.19 lakh). The main reasons for this difference were: not obeying the NABARD standards and requirements and a lot of delay in final subsidy release after JMC team visited the units.

Overall, an average, the actual amount spent by promoters for establishment of each single unit was Rs. 5.4 lakh. Among the four states, the amount spent on each unit was the highest in Punjab (8.2 lakh) followed by Maharashtra (7.6 lakh) and U.P (5.4 lakh). The amount was the lowest in case of Gujarat (3.5 lakh) which indicates the poor establishment of units. The average time taken from proposal submission to approval from financial bank was 1.65 months (roughly 50 days). The time requirement was the lowest in case of Punjab (one month) and the highest in case of Maharashtra (1.75 month). But, the time period was more or less similar in case of Gujarat and U.P states.

Table 4.5 Financial details of sample units (Rs. lakh per unit)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Total financial outlay (a + b)	5.9	6.3	5.7	5.9	5.9
Promoters contribution (a)	1.8	2.2	1.5	1.5	1.6
Bankers loan (b)	4.1	4.1	4.2	4.4	4.3
Subsidy eligible	1.5	1.5	1.5	1.5	1.5
Actual subsidy received till date	0.27	1.31	1.25	1.23	0.93
Actual amount spent	3.5	7.6	8.2	5.4	5.4
Average time taken from proposal submission to approval from Bank (months)	1.23	1.75	1.0	2.2	1.65
Sanctioned Bank type					
a. Commercial	13	1	2	15	31
b. Cooperative	0	3	4	2	9
ROI range (%)	10-12	12.5	10.5-12	11-13.75	-
Problem faced in getting approval from the financial Bank					
a. Yes	1	0	2	3	6
b. No	12	4	4	14	34

Nearly 78 per cent of the sample units were financed by commercial banks. Only the remaining 22 per cent were supported by district cooperative banks. The cooperative banks sanctioned more number of units than the commercial banks in case of Maharashtra and Punjab states. But, in case of Gujarat (100%) and U.P (88%) states; they were dominated by commercial banks. The range of interest rate on bank loans was found to be the highest in U.P followed by Maharashtra. But, these ranges were a little bit low in case of Gujarat when compared with Punjab. Only, 15 per cent of the promoters opined that they faced problems in getting approval from the financial banks.

4.5.5 Checklist for basic components in the units

The summary of checklist for basic components in the selected vermi-compost units is presented in table 4.6. As per the National Centre of Organic Farming (NCOF), capital investment subsidy scheme for promoting organic inputs manual, eight basic components were identified and checked for their availability in the sample units during field visits. In Gujarat, out of 13 sample units, none of the unit was having all the basic components. Only one unit was having seed stock, raw material and packaging etc in the state. It reveals the very poor infrastructure and maintenance of units in the state.

Table 4.6 Checklist for basic components in the units (no. of units)

Item	Gujarat (13)	Maharashtra (4)	Punjab (6)	Uttar Pradesh (17)	Over all (40)
Location (0.5 -1 acre)	7	3	6	15	31
Seed stock and raw material availability	1	3	6	10	20
Sheds (10-12 no.)	8	3	6	14	31
Concrete bed	4	3	6	12	25
Water supply	9	4	6	17	36
Store room	8	4	4	15	31
Transport system	8	2	2	8	20
Packaging	1	3	6	13	23
Over all*	0 (0.0)	2 (50.0)	2 (33.3)	3 (17.6)	7 (17.5)

***** Figures in the parenthesis indicates percentage to total units sanctioned

Similarly, out of four units in Maharashtra, only two was having all eight basic components prescribed for vermi-hatchery unit. But, three out of four units were having many of the basic components. However, in case of Punjab, only 33.3 per cent sample units were having all components. Transport system and storage were the two major missing components in 66.6 and 33.3 per cent of sample units respectively in Punjab. Only three sample units in U.P equipped with all components. The major omitted components in U.P units were transport system followed by seed stock and raw material. Overall, only seven units have fitted with all eight basic components. Highest deficiency of components was observed in case of seed stock and raw material (50%) and transport system (50%). These results clearly showed the poor infrastructure facilities in Indian vermi-hatchery units.

4.5.6 Capacity utilization of sample units

The details of capacity utilization of sample units are presented in table 4.7. Capacity utilization is a concept refers to the extent to which an enterprise actually uses its installed productive capacity. Thus, it refers to the relationship between actual output that 'is' produced with the installed equipment and the potential output which 'could' be produced with it, if capacity was fully used. The details presented in table and discussed were referring to the capacity utilization of organic input units in the last one year.

Table 4.7 Capacity utilization of sample units (TPA)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Average installed capacity	150	150	150	150	150
Current capacity utilization	24.2	187	33	105	76.2
Capacity utilization rate (%)	16.1	124.6	22.0	70.0	50.8
Average no.of working days per annum (days) @	319.6	365.0	325.0	337.0	332.0
Average working hours per day @	5.1	6.7	2.3	6.3	5.3
Average recovery rate (%) @	48.0	52.5	33.3	39.7	42.7
Gestation period per cycle (days) @	46.5	35	60	50	48.8
Avg no. of cycles per year (range) @	5-7	10-15	3-5	6-8	7-9
Expected life span of unit (years) @	8.1	12.5	10.0	10.2	10.3

@ Summarized based on their past experiences in vermi-compost production

The average installed capacity of the sample units was 150 Tons Per Annum (TPA). Overall, the average current capacity utilization was around 76.2 TPA. The average capacity utilization rate was only 50.8 per cent which indicates nearly half of its full potential. Across different states, the average capacity utilization was the highest in Maharashtra followed by U.P, Punjab and Gujarat. The actual production in Maharashtra units was more than its installed potential. The lowest capacity production was observed in Gujarat at the rate of 24.2 TPA. The capacity utilization rate was one sixth of the actual potential (16.1%). The reasons behind this are lack of demand, poor production skills and insufficient infrastructure. Even though the units in Punjab were equipped well, their productivity was low. This is because of lack of demand for vermi-compost. In case of U.P, the average utilization rate was 70.0 TPA. The demand is slowly picking up due to its nearness to different export channels in Delhi.

Data are also collected on different production indicators based on their past experiences in vermi-production. In general, the average number of working days per annum was 332 days. The number of working days per annum was higher in

Maharashtra (365 days) and lower in case of Gujarat state. The number of working days per year was on par in case of Punjab and U.P even though their capacity utilization rates were different. This may be explained with the differences in number of working hours per day. On an average, the number of working hours per day was 5.3 hours. This value was very high in case of Maharashtra (6.7 hours) while it was low in case of Punjab (2.3 hours).

On the whole, the average recovery rate per unit was 42.7 per cent. Across different states, the highest recovery rate was noticed in case of Maharashtra (52.5%) followed by Gujarat, U.P and Punjab. The high recovery rate in Maharashtra may be one of the reasons for its high productivity. Even though, the recovery rate was high in Gujarat, the productivity was low because of lack of production skills and influence of climatic parameters (high temperatures, heavy rains etc). The average gestation period per cycle for the entire sample was 48.8 days. It is dependent on various parameters like no.of worms per cubic meter, age of the worms, raw material type and production season. This period was the lowest in Maharashtra due their higher efficiency levels. It was the highest in Punjab followed by U.P and Gujarat.

Overall, the average number of cycles per annum produced by the organic inputs was 7 to 9 cycles. This number was very low in case of Punjab because of its highest gestation period. The number of cycles was the highest in Maharashtra due to its low gestation period and more number of working days per year. There was wide range of factors which could influence the number of cycles per annum per unit. In general, the mean life expectancy of the organic input units was 10.3 years. Among four states, the expected life of organic inputs was lower in Gujarat because of their poor infrastructure. The sample promoters were expressed the highest expectancy in case of Maharashtra.

4.5.7 Economics of vermi-compost production

The detailed break-up of average cost of production, yield and gross returns of sample vermi-compost units in Gujarat and Maharashtra states is presented in table 4.8. The cost of production of vermi-compost per quintal in Gujarat was Rs.453. But, the same was Rs.218 per quintal in case of Maharashtra state. The difference between them was due to the low productivity and poor capacity utilization. The productivity per annum was almost 8 times higher in Maharashtra when compared to Gujarat units. The net returns per unit per annum was higher and positive (Rs.428911) in Maharashtra while it was negative (Rs. -53076) in Gujarat. Among different cost components, the lion share was noticed in raw materials cost. It accounted for almost 55 per cent in the total cost of production in case of Maharashtra where as in case of Gujarat the share was 51 per cent. The next biggest component was labor cost (around 20 %) in Maharashtra. But, in case of Gujarat, seed stock cost occupied 26 per cent in the total cost of production. The reason for higher seed stock cost in Gujarat was repeated death of worms due to higher temperatures, heavy rains and unknown diseases.

Table 4.8 Break-up of average cost of production of vermi-compost in Western states (Rs per annum per unit)

Item	Gujarat	Maharashtra	Average
Raw material costs	56000	224500	140250
Cost of worms	28800	10476	19638
Labor costs	10269	80000	45135
Water costs	1000	2000	1500
Packaging costs	950	12332	6641
Marketing costs	0	13000	6500
Transportation costs	0	0	0
Rents, taxes, insurance if any	0	0	0
Repairs and maintenance	815	21500	11158
Interest on working capital#	11740	43656	27698
Total costs	**109574**	**407464**	**258520**
Compost production (quintals)	**242**	**1870**	**1056**
Returns from a. Compost sale b. Worms sale	 55418 1080	 794750 41625	 425084 21353
Total returns	**56498**	**836375**	**446437**
Net returns	**-53076**	**428911**	**187917**
COP of vermi-compost (per quintal)	**453**	**218**	**245**

@ 12 per cent per annum

To acquire the average cost of production of vermi-compost in Western region, the mean was calculated based on Gujarat and Maharashtra costs and returns. On the whole, the average cost of production per quintal was Rs.245. The mean net returns per unit were Rs.187917 per annum. The mean productivity per unit per annum was 1056 quintal. These results revealed that only 70 per cent of their existing capacity was utilized.

The economics of costs of production of vermi-compost in Punjab and Uttar Pradesh states are summarized and presented in table 4.9. The costs of production per quintal of vermi-compost in Punjab and U.P were Rs. 433 and Rs.324 respectively. Nearly, 34 per cent higher cost of production per quintal was observed in case of Punjab. This was due to the low productivity and higher labor costs per unit of labor. The productivity in U.P units was more than 3 times higher when compared to Punjab units. The net returns per unit per annum were Rs.18253 and Rs.371366 respectively in Punjab and U.P. The net returns per unit were much higher in U.P farms (20 times) for the same in Punjab. Amongst the different costs, cost of raw material, seed stock and labor costs were the major items in U.P units. The cost of raw material was around 10 per cent of the total costs in case of Punjab. It indicates the raw material costs were much cheaper in Punjab when compared to other states. Cost of seed stock and labor costs were occupied major shares in Punjab units.

To elicit the average cost of production of vermi-compost from Northern region, a mean was calculated by using the costs and returns data from Punjab and U.P units. Overall, the average cost of production per quintal in Northern region was Rs.350. The net return per unit per annum was Rs.194809. The average productivity per annum was 690 quintal (46%) which indicates less than 50 per cent of the existing capacity.

The summary of comparison of costs and returns between Western and Northern regions is presented in table 4.10. The cost of production per quintal was 42.8 per cent higher in Northern region when compared to Western region. But the price realization per quintal including the by product (worms) was higher (49.4 per cent) in Northern region. It indicates that the demand for vermi-compost was high in Northern states. The net margin per quintal was also very high (58.4 per cent) for Northern region. From this table, we can conclude that the production of vermi-compost was much profitable in Northern region when compared to Western region.

Table 4.9 Break-up of average cost of production of vermi-compost production in Northern states (Rs per annum per unit)

Item	Punjab	Uttar Pradesh	Average
Raw material costs	14796	96600	55698
Cost of worms	58450	96750	77600
Labor costs	50000	78660	64330
Water costs	1070	11995	6533
Packaging costs	2640	12600	7620
Marketing costs	0	345	173
Transportation costs	0	0	0
Rents, taxes, insurance if any	0	0	0
Repairs and maintenance	666	6656	3661
Interest on working capital#	15315	36433	25874
Total costs	**142937**	**340039**	**241489**
Compost production (quintals)	**330**	**1050**	**690**
Returns from			
a. Compost sale	159390	238350	198870
b. Worms sale	1800	473055	237428
Total returns	**161190**	**711405**	**436298**
Net returns	**18253**	**371366**	**194809**
COP of vermi-compost (per quintal)	**433**	**324**	**350**

@ 12 per cent per annum

Table 4.10 Comparison of costs and returns between Western and Northern regions (Rs)

Item	Western region	Northern region	% change
Cost of production per quintal	245	350	42.8
Price realization per quintal *	423	632	49.4
Net margin per quintal	178	282	58.4

* Including the sale of worms

The summary of economics of vermi-compost production across different states is presented in table 4.11. The results clearly proved that the production of vermi-compost was a profitable venture in India. The weighted average cost production per quintal was Rs.286 and price realization for the same was Rs.506. The weighted net margin per quintal of vermi-compost production was Rs.220. This is a quite significant margin in agri-business sector. Among different states, the cost of production was the highest in Gujarat followed by Punjab, U.P and Maharashtra. Good production skills, higher market demand and economies of scale of production are may be the reasons for higher productivity and low cost of production in Maharashtra. Per quintal price realization was the highest in U.P followed by Punjab, Maharashtra and Gujarat. Proximity to Delhi Metropolitan and vermi-compost export channels helped U.P state to realize more price. Even though, the productivity and market demand was relatively low in Punjab, presence of green houses and nurseries in Chandigrah facilitating to get reasonable price for vermi-compost. The average net margin per quintal was the highest in U.P while it was the lowest and negative value in Gujarat state. By administering proper training to promoters and providing technical know-how in vermi-compost production would yield good results in Gujarat state as well.

Table 4.11 Summary of economics of vermi-compost production in India (Rs)

Item	Gujarat	Maharashtra	Punjab	U.P	Weighted average
Cost of production per quintal (Rs)	453	218	433	324	286
Price realization per quintal (Rs)*	233	447	488	678	506
Net margin per quintal (Rs)	-220	229	55	354	220

* Including the sale of worms

4.5.8 Efficiency of organic input firms

The frequency distribution, mean, maximum, minimum and standard deviation of technical, allocative and economic efficiencies both under CRS and VRS models of DEA approach for sample organic input production units is presented in table 4.12. Both input and output quantities and their unit prices per unit per annum were collected and used for this efficiency analysis. The estimated mean technical, allocative and economic efficiencies under DEA-CRS model were 63.7, 50.95 and

32.95 per cent respectively. Similarly, values for the three efficiencies under DEA-VRS model were 83.39, 59.42 and 50.24 per cent respectively. In terms of technical efficiency, about 45 per cent of the sample units have more than 90 per cent efficiency under the VRS model. Under the CRS model, only 20 per cent of the sample units have more than 90 per cent efficiency. In case of allocative efficiency, majority of sample units (40 per cent) fell under less than 50 per cent category under VRS model while 47.5 per cent of the same belonged to less than 50 per cent category under CRS assumption. The economic efficiency of most of the organic inputs (85 per cent) under CRS model distributed under less 50 per cent category. Correspondingly under VRS model, the largest part of sample (57.5 per cent) were also scattered in the same class. It is concluded from the table that majority of the sample organic units (47.5 per cent) were come under less 50 per cent technical efficiency under CRS assumption, indicating that the organic production units were inefficient. To supplement the above statement, the most frequent interval of allocative and economic efficiency was 1 to 50 per cent under both CRS and VRS assumptions. Further, it signifies that the organic production units in India were suffering from both technically inefficiency in using resources as well as unable to allocate inputs in the cost minimizing way.

Table 4.12 Frequency distribution of efficiency of organic input units (n=40)

Efficiency (%)	CRS			VRS		
	TE	AE	EE	TE	AE	EE
1-50	47.5	47.5	85.0	12.5	40.0	57.5
51-60	5.0	17.5	2.5	2.5	7.5	10.0
61-70	5.0	10.0	0.0	5.0	20.0	10.0
71-80	12.5	7.5	5.0	10.0	2.5	2.5
81-90	10.0	10.0	2.5	25.0	20.0	10.0
91-100	20.0	7.5	5.0	45.0	10.0	10.0
Max (%)	100	100	100	100	100	100
Min (%)	25.4	12.8	8.8	44.6	16.3	13.4
Mean (%)	63.7	50.95	32.95	83.39	59.42	50.24
Standard deviation (%)	24.0	25.7	24.1	18.8	25.2	26.4

The average comparison of efficiencies of organic input units across states and regions is presented in table 4.13. Among the four states, the mean technical efficiency was the highest for Maharashtra followed by U.P, Gujarat and Punjab under CRS model. But under VRS model, the highest technical efficiency was found in Maharashtra followed by Gujarat, U.P and Punjab. In case of allocative efficiency and economic efficiency, Maharashtra stood first both under CRS and VRS assumptions. It indicates that Maharahstra units were much more efficient than any other states. In remaining three states, the second best units were found in U.P based on AE and EE under CRS model. However, when we compared between the two regions, a slightly higher efficiency (TE, AE and EE) values were observed in Northern region under CRS assumption. These results were also supporting the cost of production calculations found in Northern region. But, this was reversed under VRS assumption.

Table 4.13 Average efficiency of organic input units across states and regions

State (no.of units)	CRS			VRS		
	TE	AE	EE	TE	AE	EE
Avg. Gujarat units (13)	0.55	0.39	0.21	0.93	0.58	0.55
Avg. Maharashtra units (4)	0.84	0.79	0.66	1.00	0.82	0.82
Avg. Western region (17)	0.62	0.48	0.32	0.95	0.63	0.61
Avg. Punjab units (6)	0.52	0.40	0.17	0.58	0.42	0.21
Avg. U.P units (17)	0.69	0.57	0.39	0.80	0.61	0.49
Avg. Northern region (23)	0.65	0.53	0.34	0.74	0.56	0.42

The scale efficiencies among organic input production units are summarized by state wise and region wise and presented in table 4.14. The scale efficiency index among sample varied from 32.7 per cent to 100 per cent, with a mean value of 77.7 per cent. In terms of scale efficiency, about 20 per cent sample showed constant returns to scale where as 7.5 per cent exhibited decreasing returns to scale. Majority of the units (72.5 per cent) demonstrated increasing returns to scale. Among four states, the highest scale efficiency was observed in Punjab state. The same value for U.P and Maharashtra states were almost equal. Gujarat was found to be the least scale efficient when compared between them. To complement the earlier results, the mean scale efficiency value was also higher Northern region when compared to Western region.

Table 4.14 Scale efficiencies in organic input units

State (n)	CRS – TE	VRS –TE	SE
Avg. Gujarat units (13)	0.55	0.93	0.59
Avg. Maharashtra units (4)	0.84	1.00	0.84
Avg. Western region (17)	0.62	0.95	0.65
Avg. Punjab units (6)	0.52	0.58	0.89
Avg. U.P units (17)	0.69	0.80	0.85
Avg. Northern region (23)	0.65	0.74	0.86

The relationship between size of the unit and efficiency is summarized and presented in table 4.15. The sample units were classified in to three types based on their vermi-compost production per annum. Most of the sample units (65 per cent) fell under the category of small with a production of less than 50 TPA. Six and eight units respectively were grouped under medium and large categories. The results clearly indicate that there is a strong positive relationship between size of the unit and its efficiency. As the size of unit increases, all the three efficiency parameters increased significantly in almost all cases (except in Medium VRS-AE) under both the CRS and VRS assumptions. From this table we can conclude that the large units were more efficient than the smaller units.

Table 4.15 Unit size and efficiency relationship

Size of the unit	Distribution of units	CRS			VRS		
		TE	AE	EE	TE	AE	EE
Small (1-50 tons)	26	0.51	0.44	0.21	0.80	0.56	0.45
Medium (51-100 tons)	6	0.81	0.54	0.45	0.82	0.55	0.46
Large (> 100 tons)	8	0.91	0.68	0.61	0.92	0.73	0.66

4.5.9 Factors influencing efficiency of units

The results of regression analysis to identify the factors influencing efficiency (CRS-TE, VRS-TE and SE) have been summarized and presented in table 4.16. The three efficiency parameters were regressed against different socio-economic characters of the promoters and with some policy related variables (like training and subsidy). Ordinary Least Square (OLS) method was employed for estimating regression coefficients in the regression equation.

Review of various research studies has indicated that participation in the formal training programs had some influence on efficiency (Begum *et al.,* 2009). To highlight that effect a dummy variable (trained -1, untrained -0) was used to see the influence of training component on efficiency. Out of the total sample, only 27 (67.5%) promoters had formal training in vermi-compost production through NCOF and other NGOs. The remaining 13 promoters (32.5%) did not have any formal training in vermi-compost production. Similarly, researchers (Lakner, 2009) also concluded that the farms who received environmental payments and investment aid showed lower efficiency scores when compared to non-beneficiaries. To evaluate the impact of subsidy on efficiency, six more private units (3 from Maharashra and one each from remaining three states) which were not subsidized by any means were added to the existing 40 sample units. However, the sample units (n=40) got back-ended subsidy ranges from 0.5 lakh to 1.5 lakh per unit either through NABARD or NCDC. For capturing these effects, a subsidy dummy was used (subsidized-1, not-0). To perceive state wise effects, three dummies (one each for Punjab, U.P and Gujarat) were used keeping Maharashtra as a control.

The best fit among the three regression equations was scale efficiency which exhibited the highest R-square of 0.710. Amongst different factors, size of the unit was positive and significant at one per cent level. Contribution of family labor was also positive and significant at 10 per cent level. But, the age of the unit (since no.of months it’s operating) showed a negative and significant relation with scale efficiency. It indicates that the time progresses many units would become scale-inefficient. But, the exact reasons could be due to poor infrastructure of units, improper maintenance and lack of demand for the vermi-compost in these villages.

The dummy for capital incentive subsidy from NABARD exhibited negative relationship with efficiency. It concludes that with increase in subsidy amounts, the scale performance of organic input units are decreasing. The dummy for Punjab state was positively statistically significant at 1 per cent level. This indicated that the scale-efficiency difference between Punjab and Maharashtra units were significant. However, the dummies for U.P and Gujarat were also positive but not statistically significant.

Table 4.16 Determinants of efficiency in organic production units

Variable	CRS- TE Coefficient	VRS – TE Coefficient	SE Coefficient
Constant	24.39 (1.321)	67.01* (4.027)	48.37* (2.984)
Unit size	0.721* (5.369)	0.056 (0.357)	0.759* (6.314)
Education	0.002 (0.020)	0.023 (0.183)	-0.016 (-0.167)
Family labor	0.283** (2.328)	0.148 (1.045)	0.207*** (1.902)
Unit age	-0.221 (-1.588)	0.127 (0.779)	-0.343* (-2.756)
Own livestock	0.236 (1.468)	0.189 (1.006)	0.130 (0.908)
Dummy-training	0.280*** (1.905)	0.228 (1.324)	0.187 (1.420)
Dummy-subsidies	-0.167 (-1.247)	0.063 (0.402)	-0.230*** (-1.921)
Dummy-Punjab state	0.050 (0.284)	- 0.536** (-2.614)	0.466* (2.970)
Dummy – U.P state	0.133 (0.624)	-0.265 (-1.061)	0.316 (1.657)
Dummy –Gujarat state	0.194 (0.810)	0.262 (0.935)	0.069 (0.324)
No of observations (n)	46	46	46
R-square	0.638	0.505	0.710

Figures in the parenthesis indicates t –values
* Significant at 1 per cent level
** Significant at 5 per cent level
*** Significant at 10 per cent level

The R-square value of regression equation for CRS-technical efficiency was 0.638. Unit size and family labor variables were positive and statistically significant at 1 and 5 per cent level respectively. The dummy for training component showed positive relation with technical efficiency. It reveals that attending more no.of training programs will enhance the efficiency of the units. The dummy on subsidy also exhibited negative sign with technical efficiency but it was not statistically significant. When the same independent variables regressed against VRS-TE, the R-square value was 0.505. Only, the dummy for Punjab state showed a negative and statistically significance at 5 per cent level.

Overall, the size of the unit and contribution of family labor have shown positive relation with technical efficiency as well as on scale-efficiency. Training programs are also enhancing the technical efficiency of units. The age of the unit and subsidies discouraged the scale-efficiencies. Among the four states, the efficiency differences were significant between the units in Punjab and Maharashtra states.

4.5.10 Checklist for quality parameters

The checklist for quality parameters (as briefly discussed in NCOF manual) of sample vermi-compost units is presented in table 4.17. The basic qualitative parameters of a healthy vermi-compost unit were checked for their presence in the sample organic production units. None of the vermi-compost unit from Gujarat was having any of the quality parameter. Three out of four units from Maharashtra have showed all the quality parameters. Only 66.6 per cent of the sample Punjab units were demonstrated all seven quality parameters. But, in case of U.P, 6 out of 17 units met the standards of healthy vermi-compost unit. On the whole, a fraction of 32.5 per cent of the sample units accomplished the requirements. This indicates the negligence of the promoters in maintaining the units.

Table 4.17 Checklist for quality parameters in the units (no. of units)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Size of worms (2 inch length and 0.5-1 gm weight)	0	3	6	9	18
One kg of worms (600-1000)	0	3	6	8	17
Maturity period (6-8 weeks)	0	3	6	9	18
No.of cycles per year (5-12)	0	3	4	11	18
Average life span of worms (2 years)	0	3	6	8	17
Worms recovery (10 kg per ton of compost)	0	3	6	9	18
Multiplication rate (3-7 times in six weeks)	0	3	6	10	19
Over all	0 (0.0)	3 (75.0)	4 (66.6)	6 (35.3)	13 (32.5)

Note: Figures in the parenthesis indicates percentage to total

4.5.11 Loan repayment pattern of sample units

The summary of the bank loan repayment pattern of sample promoters is presented in table 4.18. Out of the total sample, only six promoters have repaid loans completely. Nearly, 85 per cent of the sample promoters were having unpaid loans with banks. The average outstanding amount per unit was Rs.2.86 lakh. This amount was the highest in Punjab followed by U.P, Maharashtra and Gujarat. Interestingly, the outstanding amount was the lowest in Gujarat. The high repayment payment capacity in Gujarat might be due to their higher non-farm income sources (like business). Almost, half of the sample promoters were categorized as regular payers by the bank authorities. In Maharashtra, all the sample promoters were rated as regular payers.

Table 4.18 Repayment pattern of sample units (Rs. lakh per unit)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Repay the entire loan					
a. Yes	2	0	0	4	6 (15.0)
b. No	11	4	6	13	34 (85.0)
Outstanding amount	1.94	2.32	4.33	3.16	2.86
Remarks from Bank					
a. Regular payers	6	4	2	9	21 (52.5)
b. Irregular payers	7	0	4	8	19 (47.5)

4.5.12 Participation in training programs and sources of information

The details of training had by the promoters and different sources of information available about new technologies for vermi-compost production are presented in table 4.19. Overall, 67.5 per cent of promoters obtained preliminary training in vermi-compost production. The rest of the promoters (32.5 per cent) did not take any formal training. But, many of them might have had informal exposures through friends and relatives. Among four states, most of the promoters (15 out of 17) from U.P have undergone this training. The presence of National Centre of Organic Farming, Ghaziabad with in U.P might have motivated many promoters to take this training.

Table 4.19 Participation in training programs and sources of information (n=40)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Over all
Had formal training					
a. Yes	6	2	4	15	27 (67.5)
b. No	7	2	2	2	13 (32.5)
Production efficiency# (scale 1-10)	7	9	7	8	8
Extent of technology# adopted (scale 1-10)	7	9	8	8	8
Having technical collaborations/help					
a. Yes	13	2	4	13	32 (80.0)
b. No	0	2	2	4	8 (20.0)
Major source of information	Relatives, Friends	KVK, RCOF	Friends, ATMA	NCOF, NGOs, Agri.Dept	-

based on farmers' self-assessment ratings but not from any quantitative analysis

In the same way, the promoters were also asked to rate (scale 1 to 10) themselves (self-assessment ratings) based on their production efficiency and extent of technology adopted in the units. Scale one indicates the lowest and ten shows the highest. On the whole, the average scale for production efficiency of the total sample was eight. They showed moderately high efficiency of the sample units than the estimated (actual) efficiencies. Between different states, the efficiency of production was the highest in Maharashtra followed by U.P. However, the self-assessment ratings were equal in Gujarat and Punjab.

Similarly, the promoters were also asked to give their self-assessment ratings (between 1 and 10) in case of extent of technology adopted in their respective vermi-compost units. The average scale of extent of technology adoption was eight. This value was also higher for Maharashtra and lower for Gujarat. Out of the total sample, 80 per cent of the units have technology collaborations with different governmental and non-governmental organizations. The major sources of information for majority of units were NCOF, RCOFs, KVKs and NGOs.

4.5.13 Problems in establishment of units

In general, most of the sample promoters did not face any problem in establishment of vermi-compost production units. Very few promoters expressed difficulties in Gujarat, Maharashtra and U.P states. But, none of the promoter encountered any trouble in Punjab. The details are listed below by state wise in the text box. Around 15.3 per cent of sample promoters in Gujarat told that they faced problems like non-availability of worms in the vicinity, lack of sufficient quality cow dung, wild boar attacks on the compost units and lack of proper guidance from NABARD. Two out of four Maharashtra beneficiaries felt that they faced problems from neighboring farmers while establishing units. A lone unit from U.P suffered from heavy rains and delay in releasing loan amount.

State	Problems in establishment
Gujarat (15.3)*	• Non-availability of worms in the vicinity • Lack of sufficient quality cow dung • Wild boar attacks on the compost units • Not proper guidance from NABARD
Maharashtra (50.0)*	• Problems from neighboring farmers
U.P (5.8)*	• Heavy rains delayed the establishment of units • Problems from bank in releasing the loan amount

* Figures in the parenthesis indicates percentage to total promoters expressed problems

4.5.14 Problems in production of vermi-compost

Around 42.5 per cent of the sample beneficiaries experienced production problems while operating the vermi-compost units. Just like any other production process, most of the problems were quite common in vermi-compost production process. The frequent problem in vermi-compost production was reduction in the outturn during the rainy season. Attack of rats and termites is a frequent problem in the production process. The specific problem in case of Punjab state was labor shortage. It accounts for higher share in the cost of production in Punjab. The major problem in case of U.P was water due to electricity shortage. In case of Gujarat, dying of worms due to fluctuations in temperature and unknown diseases is quite evident.

4.5.15 Awareness about the scheme

The summary details of awareness about NPOF scheme among the promoters is presented in table 4.20. Nearly 16 out of 40 promoters got information about NPOF scheme from friends/ others. NABARD and Bank officials also played a major role in creating awareness about the scheme. The major problem among the borrowers was development of suitable proposals for the commercial banks. About 25 out of 40 sample farmers were approached Brokers or Consultancy services for development of proposals. The average proposal development charges paid by the promoters were very high in U.P state when compared to other states.

Table 4.20 Awareness about NPOF scheme (no of units)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh
How you knew about scheme				
a. Bank person	11	1	0	1
b. NABARD	0	0	0	10
c. Brokers	1	0	0	0
d. Friends/others	1	3	6	6
Who prepared the proposal				
a. Own	7	2	2	0
b. Friend	0	0	4	0
c. Broker / NABCons	6	2	0	17
Proposal development charges paid (range)	5000-7000	5000-8000	3000-5000	25000-30000
Are you aware of contents in proposal a. Yes	8	4	6	6
b. No	5	0	0	11
Overall opinion about the scheme				
a. Average	3	0	0	3
b. Good	7	3	6	12
c. Excellent	3	1	0	2

Only 60 per cent of the sample promoters were aware of the contents in the proposal submitted to commercial banks. Overall, 28 promoters out of 40 opined that the NPOF scheme is Good.

4.5.16 Role of training programs and subsidies

The influence of training programs on efficiency of vermi-compost units is summarized in table 4.21. As presented in the previous sections, around 27 promoters had formal training in vermi-compost production either in NCOF or other NGOs. The remaining 13 did not undergo any formal training. The results clearly indicate that there are significant differences in mean capacity utilization of units between trained and non-trained group promoters. The average cost of production per quintal of vermi-compost for trained promoters was Rs.307 while the same for non-trained was Rs.340. Similarly, the mean CRS and VRS technical efficiency values were marginally higher under trained promoter units than non-trained units. But, the mean allocative efficiency values were relatively higher in non-trained units. However, economic efficiency of vermi-compost units showed a mix trend under CRS and VRS production technologies. In case of scale efficiency, the results are conspicuous and higher under trained promoter units. Overall, the results conclude that participation in training programs will enhances the production skills of the promoter as well as technical efficiency of units.

Table 4.21 Role of training programs on efficiency

Item	Trained (n=27)	Non-trained (n=13)
Capacity utilization (TPA)	82.4	68.6
Cost of production/qtl	307.0	340.0
Mean CRS-TE Mean CRS-AE Mean CRS-EE	64.9 49.8 33.0	61.2 53.3 32.9
Mean VRS-TE Mean VRS-AE Mean VRS-EE	83.7 57.9 48.3	82.8 62.6 54.3
Scale efficiency	79.0	75.0

The impact of subsidy on efficiency of vermi-compost units is presented in table 4.22. To compare the influence of subsidy on efficiency, six more non-subsidized vermi-compost units were included in the analysis along with sample (n=40) units.

Table 4.22 Impact of subsidy on efficiency

Item	**Subsidized units (n=40)**	**Non-subsidized units (n=6)**
Capacity utilization (TPA)	76.2	173.6
Cost of production/qtl	286.0*	196.0
Mean CRS-TE Mean CRS-AE Mean CRS-EE	63.7 50.9 33.0	78.8 57.5 46.4
Mean VRS-TE Mean VRS-AE Mean VRS-EE	83.4 59.4 50.2	83.0 64.2 54.3
Scale efficiency	77.7	94.5

** weighted average cost of production*

The mean capacity utilization of non-subsidized units was 173.6 TPA. It was much higher than the mean sample capacity utilization (76.2 TPA). The weighted average cost of production of vermi-compost per quintal was Rs.286 for subsidized sample units. But, the same for non-subsidized units was Rs.196. The high scale and technical efficiencies in non-subsidized units are may be reasons for low cost of production. Almost all mean efficiency values were higher in non-subsidized units than subsidized units under both CRS and VRS production technologies. There is a huge difference in scale efficiency values between these two groups. The results strongly lend support that the subsidy discourages efficiency in vermi-production units.

4.5.17 Suggestions for promoting organic input units

The suggestions for further promotion of organic input units were collected from the respondents during field visits. They were many but encapsulated them in the following items:

a. ***Prompt and timely JMC visits:*** The prompt and timely Joint Monitoring Committee (JMC) visits are the need of the hour. The delay in JMC visits was conspicuous in all the four states. Even in our sample of 40 units, 12 units so far did not complete their JMC visits. In some cases, the JMC visits were happening after more than two years of establishment units.

b. ***Quick and timely release of subsidy:*** Most of the sample units did not face any problem in receiving the advanced subsidy. But, they were facing lot of problems in getting the final subsidy. After the delay in conduct of JMCs, the release of final subsidy was also buying lot of time. Most of promoters suggested that the total subsidy should be transferred through banks directly instead of NABARD (just as in case of PMRY schemes). Although the study results proved that subsidies discouraged efficiency, NABARD has to find an innovative way of financing them.

c. ***Buffaloes, training and insurance should be integral part of the scheme:*** One of the major suggestions received from the promoters was; integration of sufficient no.of buffaloes, training in vermi-compost production and insurance for production losses if any as part of the ongoing scheme. So, the promoter would not face any difficult in getting quality raw material as well as technical assistance.

d. ***Easy licensing and certification help is needed***

Licensing and certification of vermi-compost is having the prime importance in marketing/exporting. Many promoters were completely unaware of this process. They even don't know where the labs are and who will certify it. Low cost of licensing and certification would help in easy marketing and fetching premium prices.

e. ***Supply of quality worms at cheaper rate***

The long term sustainable production and quality of the vermi-compost will depends upon quality of seed stock. It also influences the worms' health, their multiplication rate, no.of cycles per annum and recovery rate etc. The availability of such seed stock should be abundant and cheaper. This was the biggest problem in Gujarat state. Certain parts of Gujarat is also prone to extreme temperatures in summer and floods in rainy season. Earth worms are highly susceptible to these extreme climatic aberrations. A resistant species to this situation is the need of the hour to revamp the vermi-compost units in Gujarat.

f. ***NABARD/ State Government/ State Agricultural Department intervention in marketing of vermi-compost***

This was the second major suggestion received from the promoters in four states. All the promoters are looking for some window of marketing support either from NABARD or State government or state Agricultural department. The establishment of organic input marketing channels is necessary to encourage nascent organic farming in India. Other wise, Indian Farmers Fertilizer Cooperative Limited (IFFCO) should take an initiative in marketing vermi-compost just like how its market for inorganic fertilizers in India.

g. ***Encouragement of organic inputs usage by subsidization***

The government is paying huge subsidies for inorganic fertilizers in the country. The indiscriminate usage of these fertilizers resulted in land degradation, nitrate losses and environmental pollution besides creating a very unsustainable system for mankind. Keeping the long term benefits of organic farming in mind, the government should subsidize the usage of organic inputs. So, it not only encourages the farmers use but also reduces social costs.

h. Creation of market demand by promoting more awareness programs

The government has to take a proactive role in advocating and promoting the organic farming in the country. Just like in the developed countries, the government should initiative the process for establishment of ‘Green markets’ exclusively for organic food. The growing health awareness and encouragement of organic farming through conversional incentive schemes will definitely enhance the demand for organic inputs in the country.

i. Further increase in subsidy upper limit

The major problem facing by the promoters was fixation of upper limit of subsidy. The upper limit of subsidy i.e., 1.5 lakh for 150 TPA of vermi-compost unit was decided almost five years ago. But, due to increase in the costs of establishment of vermi-compost unit, the upper limit on subsidy should be increased further. It will boost the setting up of more organic production input units by small and marginal farmers in the country.

****

Chapter V

Cases on organic input units

Case study is one of several ways of doing research whether it is social science related or even socially related. It is an in-depth investigation/study of a single individual, group, incident or community. Rather than using samples and following a rigid protocol to examine limited number of variables, case study methods involve an in-depth, longitudinal examination of a single instance or event: a case. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As a result the researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. Some times, case studies lend themselves to both generating and testing hypotheses. Thus, this chapter put the thrust on eight cases among the three types of organic inputs. Two cases each were chosen from fruit and vegetable waste unit and vermin-hatchery unit and four on bio-fertilizer units (three NABARD + one NCDC sample).

Case one: Organo Phos (fruit and vegetable waste unit)

Sustainable agriculture means maintaining an agricultural growth rate to meet the increasing demand for food without hampering the basic resources, is a step towards sustainable development. Modernization of Indian agriculture, started with 'green revolution' using high yielding varieties of seeds, chemical fertilizer, pesticides, growth agents and irrigation water, has resulted in not only soil degradation and pollution; but also yielded an unsustainable agriculture system to man kind. Farmers have realized the harmful effects of long-term use of chemical fertilizers and pesticides because the crop yields are decreasing in spite of additional doses of their application. They not only pollute the environment but also contaminate the underground water due to leaching of nitrates. The only solution to these problems is 'Organic farming'.

Product development

Phosphorous is one of the most important 15 nutrients, essential for plant growth. About 98% of Indian soils are low to marginal in availability of phosphorous.

Researches on use of phospho-compost as a fertilizer in relation to yield of crops have been widely investigated under different field conditions through long term field experimentations. The results revealed that yield with phospho-compost supplying 60 kg P2O5/ha were much superior to single super phosphate applied at the same rate. Thus, it was scientifically proved that phosphatic chemical fertilizer can effectively and efficiently be replaced by phospho-compost. To take these benefits forward, Mr.S.P Puri has developed a product called ‘Organophos’ by using fruit and vegetable waste products.

Company profile

It is a joint venture between M/s Spiral services and Delhi Government for a period of 30 years to manufacture organic manure form fruit and vegetable wastes (FVW). As per the agreement, Agriculture Produce Market Committee (APMC), Azadpur, Delhi provides 150 tons of waste material per day to the plant site. It was started with the mission of timely supplying of good quality organic manure at affordable price and in the same time helping to bring an organic revolution. “Spiral Services” is a proprietary concern of a retired officer Cdr. S. P. Puri. He has diversified experience in various fields and exceptional managerial qualities. He is a well educated person having an excellent service record of 21 years of meritorious service in Indian Navy. He was heading Nature & Waste Management (I) Pvt. Ltd. as Director and had set up a MCD Compost plant at Bhalswa for converting 500 TPD Municipal solid waste into compost. He was also Director of M/s Khurana Eco-friendly ventures (P) Ltd., which is involved in the process of reviving the Okhla compost plant of MCD for 300 TPD capacity. He was honored with an International felicitation for outstanding contribution in the areas of National Building, Planning Development and Environment protection by World Environment Congress in December 1997. He has started this company i.e., Spiral services in order to make use of his ability and experience gained. This plant has formally started its production of ‘organophos’ in July 2001. The plant is situated at almost 6 acre land just outside of Delhi city. He spent more than Rs 160 lakh to set up this huge plant with 200 ton per day (TPD) capacity having a big concreted yard and processing shade with machineries and transport systems. Very good quality research and developments, strong technical backup from the best brains of the country from all fields of agriculture has made the company pioneer in this field. Their state-of-the-art infrastructure, backed with technologically advanced tools and machineries, assisted in the quality and quantity production of eco-friendly products. But, currently the plant is now working at 36% of its capacity due to lack of demand.

Type of Products

Bio-fertilizers, handmade papers and organic manures are three main eco-friendly products of the company. Ensuring the quality and effectiveness in varied grades, meeting the international quality standards, the demand of these products are enhancing day by day.

1. Bio-fertilizers

These are products which help in increasing productivity and enhance the nutrient availability to crop plants. Microbial bio-fertilizers, containing of living cells of organisms like bacteria, algae, fungi alone or in combination, help in the fixation of nitrogen, solubilization of insoluble fertilizer materials, stimulating plant growth, plant root protection or decomposition of bio-degradable material and plant residues. The products in this category can be classified as following:

- Organo-Rhizobium
- Organo-Azotobacter
- Organo-Azosiprillum
- Organo-PSB
- Organo-Algae

2. Handmade papers

They are one of the prominent manufacturer and supplier of good quality and finished handmade papers, having various applications, in India. They use eco-friendly materials and advanced technology to produce handmade craft papers in varied thickness, colors, designs and patterns as per the specifications provided.

3. Organic manure (Organo phos)

This is the main product of the company. It is very useful as base fertilizer for crops, especially in areas where botanical beneficial bacteria is less in number or there is imbalance of micro flora. These bacterial inoculants as it slowly but are continuously releases nutrients to the soil. This organic fertilizer, produced by blending organic materials like fruits and vegetables residues, leaves etc. It is available at hygienically paced in HDPE bags weighing 5 Kg, 10 Kg and 50 Kg.

Raw materials and manufacturing process

Fruit & vegetable waste from the vegetable markets of Delhi is being used as the raw material which contains all the nutrients in balanced form. They are using aerobic microbial composting technology where they are doing controlled fermentation/degradation, resulting in production of enriched compost with desired specifications and devoid of toxicity. The output of this process, mixed with microbial cultures such as Cellulolytic, Lignolytic and various useful microbes like Azotobacter, Phosphate Solublizing Bacteria/fungi (PSB) etc. Thus, the final form of the manure obtained namely ‘Organo phos’. Before packing, the product is tested in lab for its organic quality such as humus content, organic carbon, nitrogen, phosphorous, potassium and micronutrients including the population of useful bacteria, fungi and actinomyctes present in the final organic manure. The final product, black in color, is having 12% organic carbon according to FCO test where as 16-18% according to NBS test. Availability of ‘nitrogen’ is almost 15-20% whereas moisture content is about 15-25%. They are maintaining pH in between 6.5 to 7.5 which is on par with normal rate.

Unique properties and benefits

‘Organo phos’ should be used in the field before sowing or during the first or second irrigation for getting its maximum benefits. It should be mixed with garden soil five days before planting the seed or sapling. The nutrient contents in ‘organo phos’ are presented in the table below. The various benefits one can enjoy using the product is depicted in the figure 5.1.

Nutrient contents

Organic Matter (%)	Around 50	pH	6.5-7.5
Organic Carbon (%)	15-20	Nitrogen (%)	0.5 to2.0
Phosphorus (P O) (%)	2-5	K2O (%)	1.5 to 2.5
Calcium (%)	1-3	Magnesium (ppm)	0.5-1.0
Sulphur	1-3	Iron (%)	0.5-1.0
Zinc (ppm)	100-150	Maganese (ppm)	200-500
Copper (ppm)	20-50	C: N Ratio	(20+/-5):1
Microbial population	10 -10	Enriched With	AZOTOBACTOR & PSB

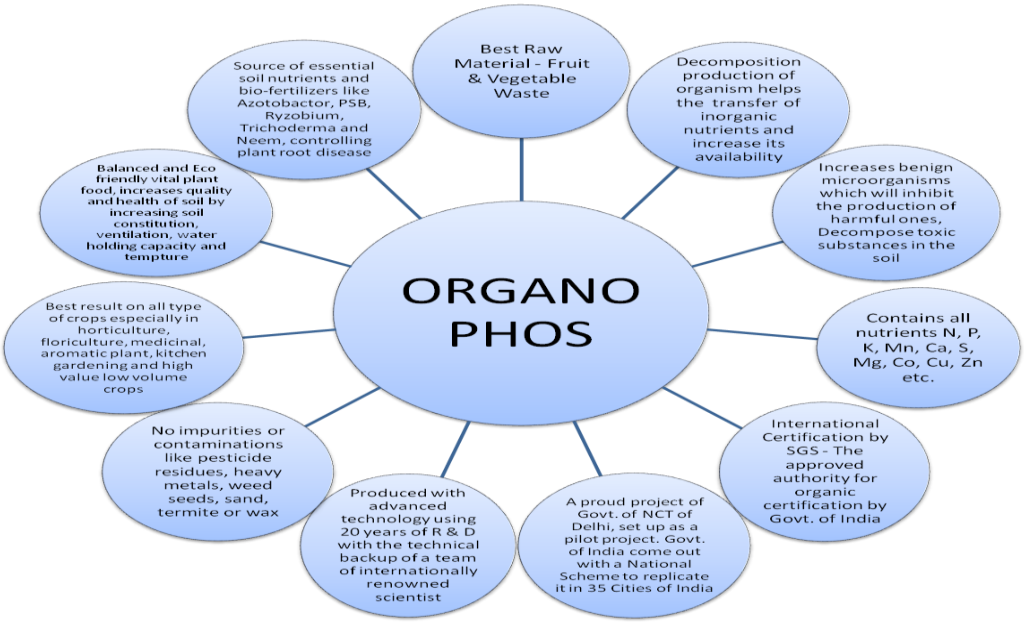


Figure 5.1 Benefits about 'Organophos'

Recommended doses

Fruit Trees	
Mango, Grapes, Litchi, Ber, Guava, Apple	6 Kg / tree
Adoo, Chiku, Lemon, Amla, Loquat, Phalsa, Kiwi	4 Kg. / tree
Papaya, Karonda, Pomegranate	2 Kg. / tree
Flowers	
Rose, Cornation	300 gms / Sqm.
Gladioli, Marigold, Rajnigandha	200 gms / Sqm.
Grass / Lawns	500 gms / Sqm.
Seedbed / Nursery	1 - 2 Kg / Sqm.
Pots (For Filling)	1:3 with soil
(For Maintenance)	50 - 200 gms / Pot
Ornamental plants and bushes	250 gm / plant Or 500 gms / Sqm.
Medicinal herbs/ shrubs	300 - 800 gms / Sqm.

Other crops

Type of Crops	Kg. per acre	Type of Crops	Kg. per acre
Rice, Wheat, Maize, Jowar	250	Rajma, Sarson, Sunflower	200
Tilhan / Sunflower, Bajra	200	Soya bean, Burseam	300
Sugarcane	350	Potato, Tobacco	500
Brinjal, Tomato, Gourd, Cabbage	150	Ladyfinger, Chilly	200
Cauliflower, Bitter Gourd	350	Carrot, Radish, Methi	200
Onion, Garlic	250	Sweet Potato, Chukandar	250
Tobacco	500	Tea	400

Marketing

They are supplying their products to various important places like President's house, Prime Minister's house, Himachal Pradesh Government, different embassies, many hotels, nurseries, corporate houses, housing societies, builders and developers, farm houses, vegetable growers, flowery culture and kitchen garden associations in and around Delhi. But, they also encounter problems in marketing the compost. Mr.Puri opined that the lack of demand, cost of compost and sales on credit basis are the major bottlenecks in marketing.

Summary details about 'organophos' unit

Sanctioned capacity	200 TPD
Installed capacity created so far	125 TPD
Current production	45 TPD
Capacity utilization rate	36 %
Financial Bank	Union Bank, Azadpur, New Delhi
Status of JMC	Completed
Status of final subsidy	'Pending'
Rate of Interest	14.25 per cent
License/FCO	Approved
Working days per annum	365 days
Recovery rate	22 per cent
Gestation period per cycle	4-5 weeks
Raw materials cost	2.5 per cent of gross income
Cost of production per Kg	Rs.1.90
Method of marketing	Direct channel
Rating for market demand	Poor
Opinion about the NPOF scheme	Good

Suggestions/Recommendations

Mr.Puri gave few suggestions for strengthening of fruit and vegetable waste units in India. They are: increase the subsidy component up to 50 per cent, providing some form of security for obtaining the loans from financial banks and implementation of Supreme Court orders i.e., use of one bag of organic manure for every 1.5 bag of inorganic- fertilizer use. He also requested for advertisement and publicity subsidies for organic input units. He emphasized the need for more 'training, education and awareness' among people towards organic food. Some of the setbacks in the production process he mentioned are influence of rains during monsoon season, labor problems, breakdown of machineries etc.

Overall, use of organic manures like 'Organophos' not only increases agricultural production in case of cereals, leguminous, oil seeds crops but also raises the productivity of sugarcane, horticulture/floriculture crops, forage grasses and medicinal plants. It also increases soil health, protects environment from getting polluted thus helps mankind and animals. This kind of plants should be replicated through out the country to fight the menace of solid waste management and threat of depleting soils due to imbalanced use of chemical fertilizers and pesticides.

'Organo phos' factory

5 kg packet of 'Organo phos'

Case two: J. K. Fertilizers (fruit and vegetable waste unit)

Being a farmer the promoter of the company, closely associated with farmers and dealers of the fertilizer across the country. They are involved in manufacturing of organic fertilizers and providing services right from initial stage of sowing to supply of finished products on time. Company offers a different range of organic inputs for sustainable agriculture and horticulture crops. These products specifically address the serious modern day concerns about environmental degradation and the threat posed to human health as a result of chemical inputs. Their organic inputs are bio-degradable, environment friendly, protect crops naturally and at the same time help to increase crop yield.

Company profile

J.K. Fertilizer is the one of the leading firms manufacturing the organic fertilizers in the Central Gujarat. They are the manufacturer of good quality organic manures under the brand name called ‘Bhoomiras’. The manufacturing unit is situated at village Adas, by the side of National High way No 8A in Anand district of Gujarat (just about 10 Km away from Anand and 3 Km away from Vasad). It was established on 23rd November, 2006 with an intention to manufacture of organic fertilizer with the use of various types of fruit and vegetable waste and compost material. The main aim and objective of the company is to fulfill customers’ requirement of best quality organic fertilizer at affordable price. The main objectives of the company are:

- To promote organic farming in the country by making available of the organic inputs such as bio-fertilizer, vermin compost and fruit and vegetable waste compost and there by better returns for produce
- To increase the agriculture productivity while maintaining the soil health and environmental safety
- To reduce the total dependence on chemical fertilizer by increasing the quantum of quality organic inputs
- To convert the organic waste in to the useful plant nutrient resources
- To prevent pollution and environmental degradation by proper conversion of organic waste

Infrastructure and manufacturing

The unit is strategically located in 1.8 acres area between Anand and Vasad. It has all the infrastructural faculties including machinery, labour, water, electricity, transport, storage godown and raw materials availability (from Anand city). The company made tie-ups with Anand Municipal Corporation for lifting the fruit and vegetable wastes from market yards. The location of the unit is also known for its agro-based products like rice waste, tobacco waste, wheat waste, poultry manure, bone meal etc. Growing awareness among farmers is also helping the company to get raw material for longer term sustainability of the project. The method of compost preparation is aerobic process. They use inoculants/cultures and cow urine for quick decomposition of waste materials. The project also obtained a “No Objection Certificate” from the concerned authorities. The company is having its own research and development centre with in the premises.

Type of products

The balanced application of 'N' is a must for higher production. But, indiscriminate use of chemical fertilizer is causing harm to the quality of land. The soil is losing its vigor and becoming less productive. That's why scientists are advising use of organic manures for long term sustainability of the soil. Their environment friendly products are produced in totally organic manner by mixing different natural input materials in proper percentages. These products increases soil fertility makes the soil soft and enhances plant growth. It also protects the plants from different pests and diseases. They are selling their products under three different brand names i.e., ***Bhoomiras**, **Revive*** and ***Amrut***. They merely differ in percentage of micronutrient contents in them. All the products are having about 16% organic carbon, C: N ratio of 20:1 and moisture content at 15-20%. J.K Fertilizers supplies the best quality organic inputs in to the market. All products are produced in strictly controlled process and supervision. Testing on a regular basis helps to achieve consistency in providing excellent quality. Specific testing regimes such as lot sample testing will be done on regular intervals by a third party.

Different raw materials used in 'Bhoomiras'

Sl no	Raw material	Available Nutrient
1	Swabin waste	N, P, K and Micro nutrients
2	Bacteria	Raizobium, Azitobactor, Phosphetbactor
3	Sugarcane waste	N, P and K
4	Poultry manure and waste	N, P, K and Micro nutrients
5	Cow dung	N, P, K and Micro nutrients
6	Ash	P and K
7	Castor waste	N, P, K and Micro nutrients
8	Cow urine	P and Mg
9	Swabin oil	N, P, K and Micro nutrients
10	Bone meal	Ca, P and Zn
11	Tobacco	Nicotine
12	Wheat, rice, and other agro wastes	N, P, K and Micro nutrients
13	Fruit and vegetable wastes	N, P, K and micro nutrients

Comparison of nutrients in ‘Bhoomiras, cow dung and vermi-compost

Nutrient	Bhoomiras	Cow dung	Vermin Compost
N	3%	0.5%	1.6%
P	2.5%	0.2%	0.7%
K	1.5%	0.5%	1.2%
Ca	5%	1%	0.4%
Mg	1%	0.3%	0.3%
S	0.5%	0.5%	0.3%
Fe	1600 ppm	300 ppm	100 ppm
Mn	280 ppm	250 ppm	150 ppm
Zn	250 ppm	100 ppm	150 ppm
Cu	40 ppm	20 ppm	35 ppm
B	10 ppm	5 ppm	5 ppm
Mo	3 ppm	2 ppm	2 ppm
Organic materials	50-60%	40-60%	30-40%
PH	7	6.8	7.2

Bhoomiras recommended doses in various crops

Crop name	Time of use	Qty per Bigha
Wheat, Rice, Cumin, Jawar, Bazra, Maize	Before planting	3 – 5 bags
Ground Nut, Castor, Tobacco, Swabin	Before planting	3 – 5 bags
Banana, Sugarcane	Before planting	10 bags
Flowers	After planting	2 bags in every 3 months
Fruits like mango, Grapes, Chickoo, Orange	Up to 1 – 5 years After 8 years	2 bags 4 bags
Chili, Tomato	Before planting	4 – 5 bags
Turmeric, Onion, Garlic, Potato, Oil seeds	Before planting	4 – 5 bags
Cotton	Before planting	2 – 3 bags

Unique features of ‘Bhoomiras’

- Best for the soil reclamation/ improvement
- It is free from weed seeds and also prevents weeds germination
- It decomposes alkaline and poisonous substance from soil and keeps soil at neutral level
- Free from all the chemical ingredients, so crop yields also free from chemical residues
- It helps in multiplying the population of earthworms and bacteria in the soil
- Checks soil born diseases & fungal diseases like yellowing and reddening of plants
- It contains high amount of NPK and other micronutrients

Marketing

J. K Fertilizers believes in direct relationships between the company and its customers. They are using both direct and indirect marketing channels for marketing of organic inputs. Under indirect approach, marketing is done through dealers as well as state agricultural department. But, the lion share of output is marketed through dealers (70 per cent). Thus, they always offer competitive prices and supplies goods to customer requirements in time. They have multi-skilled professional marketing personnel who take care of all problems arise while using them in field. Adoption of different strategies in marketing might be helping the company to do the business well. Due to its high demand from market, the cent per cent installed capacity of the unit is being in use.

Summary details about 'J.K Fertilizers' unit

Sanctioned capacity	7500 TPA
Installed capacity created so far	7500 TPA
Current production	7500 TPA
Capacity utilization rate	100 per cent
Financial Bank	Axis Bank, V.V Nagar, Anand
Status of JMC	Pending
Status of final subsidy	Pending
Rate of Interest	10.5 %
License/FCO	Approved
Working days per annum	365 days
Recovery rate	80 per cent
Gestation period per cycle	6-8 months
Raw materials cost	Rs.900 per ton
Method of marketing	Direct and indirect methods
Rating for market demand	Good
Opinion about the NPOF scheme	Good

Cost and returns from FVW compost unit (Rs lakh per annum)

Item	Amount
Raw material costs	60.00
Culture/inoculant cost	3.60
Water charges	0.45
Labor charges	18.00
Packing cost	22.00
Marketing costs	25.00
Power charges	0.24
Transport charges	18.00
Tax and insurance etc	0.22
Repairs and maintenance	0.45
Interest on working capital	12.00
Total costs	**159.96**
Total production (ton)	6000^
Gross returns	**198.00**
Net returns	**38.04**
Cost of production (Rs/kg)	**2.66**
Benefit cost ratio	**1 : 1.23**

^ recovery rate @ 80 per cent

The results from the above table clearly reveal the potential for fruit and vegetable waste compost production in Anand, Gujarat. The unit cost of production was Rs.2.66 per kg. The net return from the unit was Rs.38.04 lakh per annum. The company was selling the output at rate of Rs.3.3 per kg. The benefit cost ratio for the unit was 1: 1.23. It is a significantly good margin in this sector.

Suggestions/ Recommendations

Mr. Jiten R Vachhani, promoter of the unit gave suggestions for effective implementation of the scheme. He expressed that the development of NABARD guidelines and subsidy calculations for establishment of fruit and vegetable unit was done almost five years ago. But, due to the escalation in establishment costs, the current subsidy amount of Rs.40 lakh is not sufficient for establishing a new fruit and vegetable waste unit. So, there is a need for revision of these estimates for encouraging more promoters. He also stressed the need for establishment of marketing channels and availability of market information. He opined that the easy documentation process and more awareness programs would attract more entrepreneurs in to this venture.

The company manufacturing the organic fertilizers best suited for echo-socio balance and healthy food production. Honesty, quality and value added services are the principles of JK Fertilizers which helped them to achieve faster growth in the shorter time. Their long lasting supply relationships and use of complete line of superior quality ingredients made 'Bhoomiras' as special trade mark. Given the best resources availability, aggressive investment and thoughtful risk-taking moved the J.K. Fertilizers to the top position in Gujarat state.

IIMA study team along with the promoters

Bhoomiras packets

Case three: Agriland Bio-tech (Bio-fertilizer unit)

Agriland, a company promoted by the scientists with rich experience in the field of entomology and plant pathology is committed to scale up and commercialize biological plant protection and plant nutrition products. Right from the inception, the company has substantially been active in the promotion of biological products and to be with the tradition. Agriland is striving hard to develop environmentally sound products to keep the pace with changing farming scenario in WTO regime.

Company profile

Agriland incorporated as the private limited company in 1994. The plant and their office are situated at Motamotipura, in Baroda district, Gujarat. It was promoted by technocrats with an experience over 15 years in the area of research and development of environment friendly plant protection products. One of the promoters, Mr. Mukesh J. Patel is a young, dynamic and enthusiastic person. After passing M.Sc. in Agriculture with specialization in Plant pathology, he did three P.G. Diplomas in Business Management, Export and Import Management and Marketing Management. He participated in various national seminars, conferences, workshops, symposia and acquired the rich experience in the field of agri-biotechnology. The other promoter, Mr. Ramji Mangukia, is a very result oriented person. He passed M.Sc. in Agriculture with specialization in Agricultural Entomology. He has written various papers and scientific reports on the subject of Agricultural biotechnology and worked earlier with Coromandel Indag Products (I) Ltd, Chennai. He also worked with M/s Gujarat State Fertilizers Company Ltd, Baroda.

The company has been pioneer in promoting eco-friendly agricultural inputs. During the span of last 16 years, company has launched diverse range of products. Among them, the main products i.e., Monitor (Bio-fungicide), Yorker (Bio-nematicide) and Biosoft (Bio-insceticide) were the first of their kind in India. Apart from these products, the company has also launched many complimentary products which will help farmers to boost their incomes. Basically, it is a non-pollutant company. Moreover, it controls pollution indirectly by replacing toxic chemicals and pesticides with bio-pesticides in crop protection. All the bio-pesticides are bio-degradable, not harmful to flora and fauna including human beings. The company has been a leader in helping the Department of Agriculture, Gujarat State and the Govt. of India in standardization and registration of various biological products for legal purposes. The company participated in various extension activities like krishi mela, farmers' training, seminars, exhibitions and shouldered the responsibility to train government extension officials. The company has the track record in supplying its products successfully to the Departments of Agriculture in many States like Gujarat, M.P., Chhatisgarh, Zharkhand, U.P and Rajasthan.

Infrastructure and growth plans

The company has its own land of 146840 Sq. feet on which the manufacturing plant has been constructed in 14500 sq.feet area. The company has separate administrative, laboratory and training facilities with in the premises. They have good transportation facility of six four wheelers and twenty two wheelers exclusively for field and marketing activities. They also have latest computer software systems through which the information on references and crop production practices are maintained and updated. The company is having almost all state-of-the-art facilities right from manufacturing of the bio-fertilizers to packaging.

The company has recently established a modern R & D centre of 6500 square feet in the factory premises. The company is active in research and development with a massive objective of Lab-to-Land. The company is active in the research of key aspects of formulation and appropriate product delivery system that has direct bearing with the substantiation of laboratory findings to the large scale field applications especially of the products like entomopathogens, fungal antagonists, nitrogen fixers, phosphate solubilizers and biotic stress defending organisms. The company has an excellent investment plan in research and development of these areas with site specific product delivery systems. Looking to the current need, the company has framed a strategy to add still more unmatched quality products that can be complimentary to the present range and to expand production and marketing horizontally so as to achieve faster growth rate. The company is striving hard to launch newer products for taking the competitive advantage for some years simultaneously with the horizontal market expansion.

Type of products

1. ***Bio- pesticides***

Product name	Use
Monitor	Trichoderma viride based biofungicide
Yorker	Paecilomyces lilacinus based bionematicide
Biosoft	Beauvaria bassiana based bioinsecticide for lepidoptera insects
Vertisoft	Verticillium lecanii based bioinsecticide for the management of sucking pests
Vanguard	Neem based botanical insecticide (Azadirachtin 300 ppm , 1500 ppm and 1500 ppm)
Horsepower	Broad spectrum botanical insecticide
Sudozone	Pseudomonas flourescens based product having fungicidal, nematicidal and plant growth promotiing activities
Metasoft	Metarhizium anisopliae based bioinsecticide for the control of grubs, termites and Sucking insects

2. Bio-fertilizers (Talc based)

Product name	Use
Biofield L	Sea weed extract, Humic acid, Nitrogen fixation bacteria and Phosphate solublisation bacteria based liquid formulation for spray as complete food for plant growth.
Biofield G	Sea weed extract, Humic acid, Nitrogen fixation bacteria, Phosphate solublisation bacteria and VAM based granular formulation for soil application.
Agriland Azoto WP	Nitrogen fixation bacteria, Azotobacter chroococcum for seed treatment and soil application.
Agriland Azoto L	Nitrogen fixation bacteria, Azotobacter chroococcum for spray application.
Agriland PSM WP	Phosphate solubliser bacteria Bacillus coagulans and Torulospora globossa for seed treatment and soil application.
Agriland PSM L	Phosphate solubliser bacteria Bacillus coagulans and Torulospora globossa for spray application
Agriland KMB	Powder and liquid form of Potash Mobilizers

3. Insect sex pheromones

Product name	Use
NoMate Pheromone Traps	Sex pheromones trap devices for male insects.
NoMate Pheromone Lures	Sex pheromone lures of seven economic important pests viz. Helicoverpa armigera, Spodoptera litura, Earias vitella, Pectinophora gossypiella, Plutella xylostella, Leucinodes orbonalis and Scirpophaga incertulus.
NoMate Life TimeTraps & blocks	NoMate Life Time Traps and Lures for Fruit fly of fruit crops (Bactrocera dorsalis/correctus/zonatus) and vegetable fruit fly (Bactrocera cucurbitae).

4. Other supporting products

Product name	Use
Gibra	Gibberellic acid technical
Agrisulf	Wettable sulphur
Saffron	Micronised liquid sulphur
Apna-80	Non-ionic Adjuvants
Spectrum	Multifunctional Growth Elements for flowering and fruit setting

Marketing

The company is harnessing its full strength for promotion of various products in the field. They have many well educated and trained staff for promotional activities. The wide range promotional activities of company might have helped for better marketing their products. They have very strong dealer and distributor network across the country. They also have well established marketing linkages with many organizations like Gujarat State Fertilizers and Chemicals, Baroda; M.P. Agro Industries Corporation LTD, Bhopal; M.P. Marketing Co-operative Federation Ltd, Indore; Tarai Development Corporation LTD, Uttaranchal, Mother dairy food processing LTD, Anand; Chhatisgadh Agro Industries Corporation Ltd, Raipur; Chhatisgadh Marketing Federation Co-operative Ltd, Raipur; Gujarat State Sugarcane Federations LTD etc.

They also supply to the companies like Godrej Agrovet Ltd, United Phosphorus Ltd and Mahindra Shubh Labh Ltd. Some of their promotional activities are:

- On field products' demonstration
- Effective follow up in post demonstration period
- Farmers' meeting and educating them
- Distribution of literature in local language
- Advertisement in local TV channels
- Educating dealers/traders
- Attending the meeting of extension workers and making them aware of products and their applications
- Periodical visit to University scientists to keep themselves updated for newer developments especially on applications
- Sponsoring research programmes to the Universities for development of the products in newer crops
- Working actively in different crop development and plant protection programmes undertaken by state department of agriculture and supplying them the products as per their requirements and thereby propagating the new concepts harmoniously with the state extension wing

Summary details about 'Agriland Bio-tech' unit

Sanctioned capacity	150 TPA
Installed capacity created so far	150 TPA
Current production	150 TPA
Capacity utilization rate	100 per cent
Financial Bank	State Bank of India, Baroda
Status of JMC	Completed
Status of final subsidy	Received
Rate of Interest	12.75 per cent
License/FCO	Obtained
Working days per annum	300 days
Recovery rate	90-96 per cent
Gestation period per cycle	5 days (60 cycles per annum)
Raw materials cost	Talc Rs.5500 per ton
Cost of production per kg	Rs.75 (including all costs)
Method of marketing	Through 6-7 channels
Rating for market demand	Good
Opinion about the NPOF scheme	Good

Cost and returns from bio-fertilizer unit (Rs lakh per annum)

Item	Amount
Raw material costs	5.62
Culture/inoculant cost	0.35
Media preparation cost	18.58
Water charges	0.21
Labor charges	0.67
Salaries for technical persons	14.40
Packing cost	15.00
Marketing costs	25.00
Power charges	1.10
Transport charges	5.00
Tax and insurance etc	3.00
Repairs and maintenance	6.00
Interest on working capital	10.00
Total costs	**104.93**
Total production (ton)	142.50^
Gross returns	**162.50**
Net returns	**57.57**
Cost of production (Rs/kg)	**73.63**
Benefit cost ratio	**1: 1.54**

^ recovery rate @ 95 per cent

The above results clearly lend more support for establishment of bio-fertilizer units in the country. The average cost of production of bio-fertilizer (both liquid and power form) was Rs.73.89 per kg/lit. The unit obtained a net margin of Rs.57.57 lakh per annum. The benefit-cost ratio calculated for this investment was 1: 1.54. The results summarizes that the investment under these units was highly profitable.

Suggestions/problems

Mr.Mukesh Patel has shared some of his suggestions and problems in the bio-fertilizer production. Initially, he faced a lot of problems from Gujarat, NABARD office because there was no technical person to understand his proposal. His company also experienced the difficulty in delay of JMC visit. He also advised that the NCOF should conduct more awareness and training programs about bio-fertilizer benefits. Similarly in case of marketing; he is facing a stiff competition from ‘Gujarat Fertilizers’ because Gujarat state government is subsidizing their product’s. Low awareness of the farmers’ as well as slow results of bio-fertilizers is making hard to market the products. In some cases, government field demonstrations were not allowing to test these products.

The company has already expanded its production once in the year 2000 and further expansion of the production is in progress so as to synchronize the supply chain in expanded market. Since the people in developed nations are becoming reluctant to take food with toxic residues, the demand for bio-fertilizers and bio-pesticides are increasing phenomenally. They are also planning to export these bio-pesticides to the countries like Australia. Registration of one of the company’s product, Monitor with the Republic of Kenya and Uganda is almost on completion and ready to export. Innovative and diversified products, wide range promotional and marketing strategies have helped the company to reach this stage. With the annual turnover of around 5.5 crore (includes all segments), it stands as one of most successful bio-fertilizer company in India.

	
Agriland Biotech Office and Factory	Different Products of Agriland Biotech

Case four: Shri Dnyaneshwar bio-fert (Bio-fertilizer unit)

Shri Dnyaneshwar Sahakari Sakhar Karkhana Ltd is a cooperative society established in 1973, in project affected area of Jaikwadi dam Irrigation project, Ahmednagar District in Maharashtra. It is situated on Newasa-Shevgaon road about 11km away from Ahmednagar-Aurangabad highway. Late Marutrao Ghule Patil was the founder chairman of the factory. It was registered under Maharashtra Cooperative Societies Act, 1960 dated 19-10-1970. Due to the availability of dam water the potentiality has increased for growing sugarcane in this area. Later, growers of these talukas came together under the leadership of Mr. Patil and established the factory.

Cooperative profile

The Cooperative society is operating in 92 villages of Newasa and 122 villages of Shevgaon taluka, making a total of 214 villages within a radius of 60km. Initially, the society has started with 4243 members and Rs 36.74 lakh of share capital. Today, it has gone up to 14873 members and Rs. 1061.88 lakh of share capital. Currently, the annual turnover of the society is to the tune of Rs 170 crore whereas the capital assets of the society are of around Rs. 150 crore. The society is having very good reputation in Ahmednagar district as well as in Maharashtra state. It has won several national and international level awards like, National Productivity Award from National Productivity Council, New Delhi in 1985-86; National Efficiency Award from Department of Food, Government of India in 1987-88; Efficiency Award in 1988-89 from National Federation of Cooperative Sugar Factories and Reduced Overall Recovery Award from Vasantdada Sugar Institute, Pune in 1993-94. They also got ISO 9002 certificate in the year 2000. The land of this area is either black cotton soil or very light soils from leveled to undulate. The main source of irrigated is from Mula right bank canal and Jayakwadi back water. The rainfall of the area is low and uneven ranging from 15 to 60 mm. The temperature is moderate to high ranging from 17°C to 45°C which is congenial for sugarcane.

Sugar factory

The factory got first industrial license to manufacture white crystal sugar and started its production in the year 1974-75 with 1250 TCD capacity at 6% recovery rate. They have increased the capacity of sugar factory upto 2000 TCD in the year 1981-82 due to surplus production cane in that area. Later the capacity was further increased to 3000 TCD in 1991-92. In 2001-02, the capacity once was again increased to 5000 TCD. Recently in 2008-09, its capacity has increased to 6000 TCD due to modernization. Now, the factory is expected to crush around 7000 TCD capacity in the year 2009-10. Though, they were crushing at 10.70% recovery rate in 2008-09; they have achieved a peak recovery rate of 12% in the year 2002-03. They paid more than Rs.1200 per ton to farmers for buying sugarcane during the year 2008-09. The factory is efficiently using its resources for production of wide range of by-products. They are distillery, extra neutral and absolute alcohol production, methane gas production and co-generation of electricity etc.

Cane development activities

The society is encouraging its members with a wide of development activities for better productivity and quality of the cane. Among various activities, establishment of vermi-compost and bio-fertilizer units were the major initiatives to preserve the soil health and sustainability. The other activities are supply of nucleous seed, soil testing, providing extension services, drip irrigation subsidies and credit facilities.

1. Vermi compost project

A vermi-compost unit with 300 MT per annum capacity is installed by the society. They are selling the product at a very cheap rate of Rs. 1500 per ton to protect soil structure and texture. Another compost project from press-mud and spent-wash is also installed and the product is being sold at Rs.200 per ton.

2. Bio-fertilizer Unit

In January, 2008 the society has decided to set up a bio-fertilizer unit with an aim to produce quality bio-fertilizers and making it available to their members at a cheaper rate. They established the bio-fertilizer unit, with an installed capacity of 150 TPA in the span of six months by spending almost Rs. 80 lakhs under NPOF scheme. They got Rs. 39.86 lakh as loan from State Bank of India, Shavgaon branch and Rs 10 lakh as the advance subsidy from NABARD. The Joint Monitoring Committee has visited the unit. They are yet to receive the second installment of the subsidy amount. Currently, the unit is producing 100 tons of bio-fertilizers per annum. The average capacity utilization of the unit is 66.66 per cent.

Infrastructure and R & D

They installed almost all the necessary equipment in the bio-fertilizer unit. One R & D laboratory was also attached with bio-fertilizer unit. Equipments like fermentor, laminar air flow station, autoclave, boiler, air compressor, coolers, vacuum pump, blending machines, centrifuge, reactor etc were observed in the unit. They have enough storage space in the godown. Sophisticated weighing and packing machines were also equipped. The unit is having its own transport vehicles for bringing the materials as well as for distributing the finished products. They have employed more than five skilled persons to take care of the plant. The plant is also having technical collaboration with Agricultural Universities and research stations.

Types of products (Lignite based)

Bio-fertilizers are based on bacteria, fungus and yeast which fixes required nutrient like nitrogen, phosphorous and potash in the soil. They are producing mainly Lignite based quality bio-fertilizers with almost 90-95% recovery rate. The average gestation period per cycle is 8 days and they are doing 4 cycles per month. Even though the products are not crop specific, but still they are mainly targeting for sugarcane crop. The bio-fertilizers production was good and meets the quality standards like average viable cell count 10^7 per ml and no contamination up to 10^5 dilutions. The pH is maintained within the neutral range of 6.5 - 7.5. The average moisture content is 30-40%, at par with the standard rates. The table below summarizes their product range of the unit:

Azotobacter	Azotobacter Chroococcum, Nitrogen fixation bacteria
Asetobacter	Asetobacter sp., Nitrogen fixation bacteria
Azospirilium	Azospirilium sp., Nitrogen fixation bacteria
PSB	Bacillus Coagulans and Torulospora Globossa, Phosphate solubliser bacteria
Rhizobium	Rhizobium sp., a symbiotic Nitrogen fixing bacteria
K Mobilizer	Provides K_2O to the plant
D.C. Culture	Bacteria being used for decomposing of organic materials

Marketing

The products of bio-fertilizer unit are mainly intended to supply its member farmers/cane growers. But due to lack of awareness, the demand for these products is average. So far, the society is selling their products only among its members at Rs 25 per kg. No other form of marketing channel was used. Society is popularizing these kinds of products in this area mainly to improve the soil quality.

Publicity

The Agri Gut Offices of the society provide information to the sugarcane farmers regarding seed supply, subsidized schemes, irrigation related schemes, doses of fertilizers, micro-nutrients, bio-fertilizer, weedicides, horticulture, cane development schemes through different publications and field demonstrations.

Summary details about 'Shri Dnyaneshwar bio-fert' unit

Sanctioned capacity	150 TPA
Installed capacity created so far	150 TPA
Current production	100 TPA
Capacity utilization rate	66.66 per cent
Financial Bank	State Bank of India, Shavgav branch
Status of JMC	Completed
Status of final subsidy	Pending
Rate of Interest	13.25 per cent
License/FCO	Obtained
Working days per annum	365 days
Recovery rate	90-95 per cent
Gestation period per cycle	8 days (48 cycles per annum)
Raw materials cost	Lignite Rs.7000 per ton
Method of marketing	Only for society members
Rating for market demand	Average
Opinion about the NPOF scheme	Good

Cost and returns from bio-fertilizer unit (Rs lakh per annum)

Item	Amount
Raw material costs	5.98
Culture/inoculant cost	0.10
Media preparation cost	5.60
Water charges	0.24
Labor charges	0.60
Salaries for technical persons	6.00
Packing cost	1.50
Marketing costs	0.00
Power charges	1.00
Transport charges	0.00
Tax and insurance etc	0.20
Repairs and maintenance	0.75
Total costs	**21.97**
Total production (ton)	100.00^
Gross returns	**25.00**
Net returns	**3.03**
Cost of production (Rs/kg)	**21.97**
Benefit cost ratio	**1 : 1.13**

^ current capacity utilization @ 66.6 per cent

The above results clearly confirm that the investment in bio-fertilizer unit is highly profitable. The unit was started earning marginal net profits even at the capacity utilization rate of 66.6 per cent. The Cooperative society is till now selling at a marginal profit to only their members. But, they have not yet started the commercial sales to outsiders of the society. The unit was currently operating at a benefit cost ratio of 1:1.13.

Suggestions/problems

The managing team of bio-fertilizer unit expressed their problems and suggestions about the NPOF scheme. The prime suggestion was about the timely release of subsidy funds. The JMC has visited the unit almost six months back, but still the final installment of the subsidy is yet to be received. They are also looking for state government as well as Agricultural university support for marketing of the bio-fertilizers. The unit was also facing a problem of raw material scarcity i.e., lignite or talc powder. They also requested the Union government to remove the ‘VAT’ on the sales of bio-fertilizers.

The society has a broad and diversified portfolio. Cooperative is very balanced in use of all their byproducts from sugarcane. They are very good in targeting the problems of cane growers right from the good seed to end product. The society is also encouraging the small and weaker farmers through diversified income generation activities like growing fruit crops, vegetables, sericulture, poly houses etc. The management of the society has taken several initiatives like compost production, vermi-compost sales, drip irrigation subsidies and finally supply of bio-fertilizers to mainly protect and preserve soil and natural resources of that region. But still many of the society members don’t have good awareness about the benefits of these initiatives. However, the momentum for usage of bio-fertilizers is taking place slowly. Overall, the society has succeeded in their efforts to increase the productivity substantially from sugarcane fields which is evidenced from increase in the capacity of sugar factory from 1250 TCD to 7000 TCD in a span of 35 years.

Cultures stored at the plant

Dnyaneshwar bio-fertilizers in 1kg pack

Case five: Sree Ganapati Jilha Krishi Audhyogik Sarba Seba Sahakari Society Ltd – Bio-fert cum organic fertilizer (Organic fertilizer unit)

This unit was sanctioned under Corporation Sponsored Scheme by National Cooperative Development Corporation (NCDC), Fertilizer and Inputs Section, New Delhi in 2003. NCDC has directed the state Government of Maharashtra to set up a Bio-fertilizer cum organic fertilizer project with a block cost of 90.0 lakh. But, so far state Government of Maharashtra has released only 40.5 lakh to the society due to some reasons. So, the society has established only one part i.e., only organic fertilizer unit. They bought the site for bio-fertilizer unit and waiting for balance financial assistance from the State Government.

Society profile

This organization was established by Mr. Chintamanraoji Patwardhan Rajesaheb in 1926. The society is providing restless services to members, farmers, customers, cooperative societies and common man for last 82 years. The cooperative is situated at Vasant Market Yard at Sangli in Maharashtra. They have 4435 members and having savings amount more than Rs. 1.6 crore at the end of 31st March, 2008. The society has under taken a broad range of projects. The wide spread activities includes godowns, organic & bio-fertilizer project, grape wine project, shopping centre at vasant market yard, sugar factory, cooking gas supply unit etc. They are planning to start a few new projects namely, grape winery project, sugar factory connected distillery & co-generation etc. To initiate these projects a huge amount investment would be required. They are in connection with the following banks in the region:

a) State Bank of India, Tasgaon Branch
b) Sangali District Central Cooperative Bank Ltd, Sangali
c) Rajarambapu Cooperative Bank Ltd., Peth
d) Axis Bank, Sangali

Different activities undertaken by society

1. Godown building of 10000 MT capacity: Assistance was obtained from Central Government through direct funding to built the village godowns. The entire loan amount was repaid with two years. Through this infrastructure, currently society is getting more than 30 lakh rent per year.

2. Shree Ganpati district – Tasgaon Sugar factory unit: The society owns a big sugar factory. Total sugarcane production in the area is about 3lakh MT in the year 2007-08. The sugar produced was more than 3.7 lakh quintal at a good recovery rate of 12.31 per cent. More than 90% of the sugar produced was exported. Because of good quality production they are getting good price for their sugar. Hence, they don't have any marketing and financial problems. Thus, the society is paying good dividends to its farmer members.

3. Organic and bio-fertilizer project: Under development scheme of National Cooperative Development Nigam, this project was started. NCDC, Pune financed this project under NPOF scheme. By utilizing the first phase amount (Rs.40.5 lakh), they established the organic fertilizer unit in 2004. Society has created its own brands "Shree Ganpati Chap Sendriya 5:10:5 and 5:10:0." Under the second phase, the establishment of bio-fertilizer unit is pending. The table below shows production and total sales details of organic fertilizer unit:

Year	Production in Ton	Total sales in lakh
2006-07	650	38.20
2007-08	525	28.07
2008-09	575	30.00
Targeted in 2009-10	1000	75.00

Raw materials and manufacturing

The organic fertilizer unit uses the raw materials like bone meal, leather powder, potash, micro nutrients etc. Two forms of organic fertilizer mixtures are producing by mixing the N: P: K in the proportions of 5:10:5 and 5:10:0. They installed a huge mixture machines for this purpose. Finally, the end product is mixed with micro-nutrients also.

Unique properties

Very good quality organic fertilizers at very low cost are the recipe of the success. These fertilizers are useful for most of the crops and especially for Mango, Grapes, Banana and vegetables. These fertilizers release the nutrients slowly and prevent the nitrate losses in the soil. It also protects the soil texture and micro-organisms.

Major nutrients	Nitrogen (5%), Phosphorus (10%) Potash (5%)
Secondary nutrients	Calcium, Magnesium, Sulphur
Micro nutrients	Zinc, Ferrous, Manganese, Boron

Recommended dosages

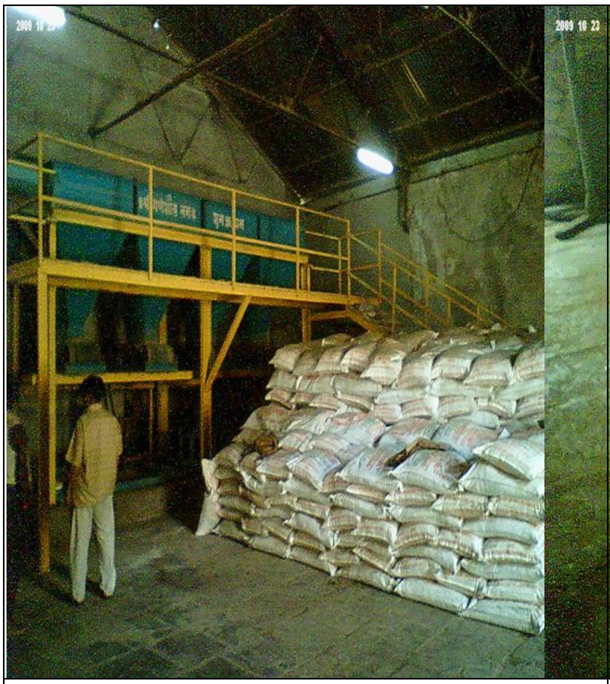
Crop	**Qty per acre**	**Time of use**
Grape	1000 kg 500 kg	October March
Orange, Lemon	1 kg 2 kg 10 kg	1-2 years 2-5 years More than 5 years
Chickoo, Guava	2 kg 8 kg 15 kg 20 kg	Upto 2 years Upto 4 years Upto 7 years After 7 years
Banana	1000 kg	While planting
Mango	5 kg 30 kg 40 kg	After 2 years After 8 years After 13 years
Pomegranate	750 kg	8 days before plucking
Sugarcane	500 kg	During land preparation
Turmeric, Onion, garlic	400 kg	During land preparation
Coconut, Cashew	1 kg 10 kg	During land preparation After 4 years

Marketing

The society is using both direct and indirect methods of marketing. Under the direct marketing channel, around 60 per cent of the total production gets marketed. The remaining 40 percent of the output is being market through dealers. Overall, the market demand is good for organic fertilizers. Brand value, image of the society, good quality of fertilizer and cheaper price are the strong forces pushing the product well in the market. The society is also marketing their products in Konkan region, Nashik region and rest of West Maharashtra region.

Summary details about 'organic-fertilizer unit'

Sanctioned capacity	3000 MT per annum
Installed capacity created so far	3000 MT per annum
Current production	600 MT per annum
Capacity utilization rate	20.0 per cent
Financial Bank	NCDC, Pune Regional centre
Status of JMC	Under the supervision of NCDC
Status of final subsidy	Obtained
Rate of Interest	8.5 per cent
License/FCO	Obtained
Working days per annum	240 days
Recovery rate	98 per cent
Gestation period per cycle	Not applicable
Raw materials cost	Rs.8000 per ton (bone meal)
Method of marketing	Direct and indirect method
Rating for market demand	Good
Opinion about the NPOF scheme	Good



Machinery producing the fertilizer	Finished product, ready for packing

Cost and returns from Organic-fertilizer unit (Rs lakh per annum)

Item	Amount
Raw material costs	42.00
Culture/inoculant cost	0.00
Media preparation cost	0.00
Water charges	0.00
Labor charges	0.72
Salaries for technical persons	0.00
Packing cost	2.40
Marketing costs	0.12
Power charges	0.15
Transport charges	0.00
Tax and insurance etc	0.10
Repairs and maintenance	0.08
Total costs	**45.57**
Total production (ton)	600^
Gross returns	**48.00**
Net returns	**2.43**
Cost of production (Rs/kg)	**7.60**
Benefit cost ratio	**1 : 1.05**

^ current capacity utilization @ 20.0 per cent

The results clear indicate the profitability of investment in organic-fertilizer units in Maharashtra. The current capacity utilization of the unit was low at 20.0 per cent due to lack of demand. With increase in the capacity utilization, the unit would get more profits in the years to come.

Problems/suggestions

The management team of the society highlighted the problems in operating the unit. They are facing long delay in financial approvals from NCDC as well as from State Government of Maharashtra. Marketing the organic fertilizer is another major problem. Due to low awareness of the farmers, they are trying hard to convince them. Slowly, the sugarcane and orchard growers are realizing the importance of organic fertilizers. They are also facing difficulty in getting sufficient quantity of raw materials for the unit. Labor availability and power shortages also hindering the production process. Because of all these setbacks, the unit is operating at very low capacity utilization rate. Finally, the society is eagerly waiting for the phase-II financial assistance for establishing a bio-fertilizer unit.

By diversifying their portfolios in different ventures, the society is trying to grow further. The society is having good number of fixed capital assets like godowns, shopping complex and gas agency etc. The organic fertilizer they are producing is unique in its character and nutrients prepared based on commonly available raw materials. Due to their high quality and low cost, they are able to convincing the farmers in this region. Further financial assistance from NCDC and state government may raise their profits phenomenally.

Case six: Antecedent Pabulum Inc (Bio-fertilizer unit)

It is a lone bio-fertilizer unit sanctioned under NPOF scheme by NABARD in Punjab state. The main aim of the unit is reducing the technological gap between research laboratories and farmers fields. Dr.Prem Narayan Singh, partner of the business opined that the actual research in the field of bio-technology is not reaching to the area of bio-fertilizers. If transfer of these technologies could have happened, it would further reduce the cost of bio-fertilizer further.

Company Profile

Antecedent Pabulum Inc. (API) was incorporated as a biotech company in the year 2006 in Bathinda district, Punjab. Company is showing a repaid growth in the area of technology development and commercialization of a wide range of agri-bio-inputs for plant nutrition and plant protection. It is also engaged in the production of feed additives for live stocks and poultry birds by using appropriate bio-techniques. Company specializes in the development and manufacture of liquid and carrier based bio-fertilizers and bio-pesticides. The unit is having very high colony forming species for fertigation and soil application. It seems obvious that a healthy plant is more able to withstand the effect of pests and diseases. But at API, this concept has been taken further with the development of a range of products designed to maximize the health and vigor of crops and thereby to increase their ability to withstand with pests and diseases.

Infrastructure and growth plans

The company has all required facilities for bio-fertilizers production. They have four fermentor (own manufactured), laminar air flow station, autoclave, boilers, air compressor etc. The unit is having enough storage and packing space. The company is also having a four wheeler and generator facilities. They have their own R & D lab with sufficient number of technical personnel. They have good technical collaborations with premier institutions like PAU, NCOF, BHU, IARI etc. The company has growth plans to replicate the technology by setting of micro-units at village level in association with different agricultural co-operative societies/farmers clubs in order to increase their availability at economical rates. The company is also planning to produce cyno-bacteria cultures especially for enhancing the yields in paddy crop. The team is also working on the production of ‘Spirolina’, which is a rich source of protein as well as anti-oxidant for poultry.

Types of products (Talc based)

1. ***Bio-fertilizers***

Nitrofix	Azotobacter sp., a free living soil inhibiting nitrogen fixing bacteria
Native	Phosphate solubilizing bacteria
Garrison	Azospirillium sp. an associative nitrogen fixing bacteria
Oedema	Rhizobium sp., a symbiotic nitrogen fixing bacteria

2. ***Bio-pesticides:*** These are the products based on bacteria, fungus, viruses and botanical extracts which kill the target insects, pests, disease casual organisms on a very efficient manner without any disturbance of ecological balance.

Tricoguard	A 1.0% W.P. formulation of Trichoderma viride and is used for the management Sclerotonia, Phytophthora, Pythium, Rhizoctonia, Fusarium, Sclerotium etc.
Geoguard	A 0.5% W.P. formulation of Pseudomonas fluorescence and is used for the management of bacterial leaf blight of paddy, sheath blight of paddy, root and foot rot of vegetables etc.

Summary details about 'API' unit

Sanctioned capacity	250 TPA
Installed capacity created so far	250 TPA
Current production	500 TPA
Capacity utilization rate	200 per cent
Financial Bank	Bank of Baroda, Bathinda branch
Status of JMC	Completed
Status of final subsidy	Obtained
Rate of Interest	11.00 per cent
License/FCO	Obtained
Working days per annum	300 days
Recovery rate	90 per cent
Gestation period per cycle	3-5 days (50 cycles per annum)
Raw materials cost	Rs.5000 per ton (Talc)
Method of marketing	Indirect
Rating for market demand	Very good
Opinion about the NPOF scheme	Good

Fermentor

Bio-fertilizers in drams, ready for sale

Cost and returns from bio-fertilizer unit (Rs lakh per annum)

Item	Amount
Raw material costs	18.00
Culture/inoculant cost	1.00
Media preparation cost	4.59
Water charges	0.50
Labor charges	6.00
Salaries for technical persons	13.00
Packing cost	60.00
Transport and marketing costs	60.00
Power charges	3.60
Tax and insurance etc	0.05
Repairs and maintenance	12.00
Working capital	12.00
Total costs	**190.74**
Total production (ton)	500.00^
Gross returns	**300.00**
Net returns	**109.26**
Cost of production (Rs/kg)	**38.14**
Benefit cost ratio	**1:1.57**

^ current capacity utilization @ 200.0 per cent

The above results show the high profitability of bio-fertilizer production in Bathinda, Punjab. The cost of production of bio-fertilizer per kg was Rs.38.14. The unit is earning a net profit of Rs.109.26 lakh per annum. The benefit cost ratio of the unit was 1: 1.57.

Marketing

The API is marketing its 98 per cent production through indirect marketing. They have very strong network of dealers all over the state of Punjab. Nearly half of their cost of production is incurring towards marketing of the products. Their products are always timely available in the market. The company experiences its peak demand during the period of July –Sept in a cropping year. Overall, they are not facing any marketing problems. It is also proved by high capacity utilization of the unit.

Problems/suggestions

Mr.Prem Narayana has expressed few problems in production of the bio-fertilizers. They are: difficulties in the preservation of liquid Rhizobium culture in the bottles. The bottles are bursting due to the gas formation from the culture. They are also facing the difficulties in P^H matching. The company is packing the cultures at 20 per cent moisture level against the recommendation of 30-40 per cent. This is due to avoid the contamination problems in the cultures.

The broad vision of the company is to improves the texture and porosity of the soil and maintain its P^H. Safeguard the eco-system by using beneficial micro-organisms which are supplemental to chemical fertilizers and pesticides. The usage of bio-fertilizers not only minimizes the chance of soil, water and air pollution caused by the excess use of chemicals but also reduces the subsidy burden of the government. The effective usage of these products reduces the cost of cultivation and increases the productivity of crops by 15-20 per cent. Ultimately, they are helping in improving the incomes and employment of the farmers in Punjab. Finally, the company has succeeded in achieving their goals.

Case seven: Vitthal Rukhmini Gandul Khat Prakalp (Vermi-hatchery unit)

Mr. Sahebrao Ganpat Bhand, promoter of Vitthal Rukhmini Gandul Khat Prakalp, is the only son of his father Ganpat Kachru Bhand holding 2.4 ha of ancestral land in the village Dadh Khurd, Sangamner taluka, Ahmednagar district in Maharashtra. He cultivates his land under the command area of left bank Pravara canal of Bhandardara dam. He studied upto 11th standard before taking up farming as his primary occupation at the age of 18 years.

He later came in contact with Krishi Vigyan Kendra (KVK), Babhaleshwar district Ahmednagar located 13 k.m from his home. The scientists of the KVK convinced him in the improved methods of farming by participating in the front line demonstration program on Bengal gram. His yields in that year improved from the existing 4 to 9.5 quintals from 0.40 ha area. The KVK further helped him to establish a Kranti farmers club in 1999 in his native village bringing into the mainstream other village youth and farmers to participate in new and improved farming. Later he along with other members of the farmers clubs was given support for establishing a small scale vermi-compost unit yielding compost for his crops. He initially utilized vermi-compost for lime crops that helped him improved yield and quality of fruits. He also secured higher yield of 80 quintals per acre per annum from the existing 60 quintals. He was convinced with use of this environment friendly vermi-compost which helped him in improving yield and productivity. He later started promoting the concept of organic farming and actively participated in organic farming programs of KVK.

As the awareness of farmers on use and benefits of vermi-compost grew, it became apparent that the demand for vermi-compost would increase and there would be no suppliers who could match the demand for vermi-compost from farmers. Thus, he thought of establishing a permanent structure of vermi-compost unit of size 30ft X 30 ft with production capacity of 5 tons. He utilized a part of this vermi-compost production for his crops and the remaining sold to other farmers successfully. As the demand for vermi-compost grew he undertook the benefit of various Govt schemes for starting a vermin-culture hatchery for distributing earthworms to other farmers and youths. He established a very innovative hatchery from the spent-slurry of biogas plant. The results were encouraging and he made an improvised arrangement for rearing and multiplying vermin-culture hatchery. This helped him to sell and distribute 100 to 150 kg vermin-culture per year. Further he expanded the vermi-compost unit to a size of 7320 sq.ft area investing Rs 9.50 lakhs with support of Rs 4.0 lakhs as bank loan from Ahmednagar District Central Coop Bank, Chanegaon and 1.5 lakhs subsidy from government under NPOF scheme with annual production capacity of 400 MT of vermi-compost.

The unit was duly registered as small scale industry under District Industries Centre. Further, he also obtained manufacturing license and sale license for vermi-compost unit from the Department of Agriculture. He has plans to export the vermi-compost for which he legally obtained Import Export code from Joint Directorate of Foreign Trade, Pune. The production of vermi-compost, vermiculture and vermi wash has been supplied to 3000 farmers for enhancing their production capacity several times. The unit employs 9 labours with 2 males and 7 females round the year from his village. There are 7 other labours who seek secondary employment from supply of vermi-compost and other products.

Summary details about 'vermi-hatchery unit' (dung based)

Sanctioned capacity	150 TPA
Installed capacity created so far	400 TPA
Current production	400 TPA
Capacity utilization rate	100 per cent
Financial Bank	ADCC Bank Ltd, Ahmednagar
Status of JMC	Completed
Status of final subsidy	Obtained
Rate of Interest	12.5 per cent
License/FCO	Obtained
Working days per annum	365 days
Recovery rate	70 per cent
Gestation period per cycle	50 days (7 cycles per annum)
Raw materials cost	Rs.500 per ton (cow dung)
Method of marketing	Direct method
Rating for market demand	Very good
Opinion about the NPOF scheme	Excellent

Part of Mr.Bhand vermin-compost unit

Mr. Bhand explaining the production process to IIMA study team

Cost and returns from vermi-compost production unit (Rs per annum)

Item	Amount
Raw material costs	325000
Cost of worms	25000
Labor costs	100000
Water costs	50000
Packaging costs	150000
Marketing and transport costs	50000
Rents, taxes, insurance if any	5000
Repairs and maintenance	75000
Interest on working capital #	93600
Total costs	**873600**
Compost production (Qtl)	4000
Returns from	
a. Compost sales	1600000
b. Worms sales	100000
Total returns	**1700000**
Net returns	**826400**
COP of vermi-compost (per qtl)	**218.4**

@ 12 per cent per annum

The above results have proved that he is one of the efficient producers of vermi-compost not only in Maharashtra state but in India as well. The cost of production of vermi-compost was Rs.218.4 per qtl. This value was much lesser when compared with all three remaining states. The unit was earning a net profit of Rs.8.26 lakh per annum. The unit was earning almost double the income than the costs incurred to it.

Marketing

He is marketing his entire production through direct sales. He is not only selling his products in Ahmednagar district but also in the surrounding districts and states. Mr.Bhand has also obtained all necessary certificates required for export to other countries. His good reputation as well as maintenance of quality is helping him well in the marketing of the product. He also opined that the delayed payments by farmers and less demand during summer are some of the bottlenecks in marketing.

Suggestions

Mr.Bhand made few suggestions for effective implementation of the scheme. He felt that the advance and final subsidies should be released timely and JMC visits should be completed quickly. He stressed that the government departments and local universities should support or help the promoters in marketing of their vermi-compost. He also expressed that the current subsidy amount of Rs.1.5 lakh should be enhanced further due to escalations in the costs of establishment.

Mr.Bhand is a classic example for successful entrepreneurs in the field of vermi-compost production in India. With in a span of a decade, he has proved himself as a role model in this area. His dynamic personality coupled with quick adoptive nature has helped him to reach pinnacles of life. By proper blending of modern techniques with his innovative ideas, he has succeeded both in crop production as well as vermi-compost production.

Case eight: Warana cooperative society (private vermi-hatchery unit)

Warananagar is a small town, situated at the foothills of Panhala-Jyotiba hill ranges in Kolhapur district of Maharashtra state. Warana cooperative society is an ideal example of integrated rural development. The region has transformed from a barren tract of land to an epitome of cooperative movement in last few decades. Late Tatyasaheb Kore, the architect of the dream, aspired of creating a New Man – “Nava Manus”. Today, the cooperative society has links with 25 cooperative societies and having a turnover more than Rs.600 crore. The sugar factory and people of the cooperative keep the belief in empowering and raising awareness of the farmers. The major activities of the society are:

1. Warana cooperative sugar factory

Warna is traditionally known for the sugar cane cultivation and conversion of sugar cane to Jaggery and selling it in to the nearby developed market of Kolhapur. “Price of Jaggery fluctuate but not the price of sugar” was the basis behind establishing this factory. Right from the very first year, it touched horizons of success by producing more than 8 lakh bags of sugar at 12.72% recovery rate. Tatyasaheb Kore Warna co-operative sugar factory has got Union Commerce and Industry Ministry's "Star export house grade" accreditation. Warna sugar factory is the first in the country to earn such an honor. The factory exported sugar about 12 lakh and 11 lakh quintal in the current and previous years respectively. Tatyasaheb Kore Sakhar Karkhana Ltd at Warna nagar has 69 villages in the area of operation with 10,800 ha of land under sugar cane production in the year 2009-2010. Today, the capacity of the factory is 9000 TCD with almost 13% recovery rate. In almost all years since 1982-83, actual price paid is higher than SMP and in the last two years, it is more than double. Various cane development schemes are implemented by the sugar cane factory to increase the productivity of sugar cane with usage of minimum inputs. They are providing inputs like chemical fertilizers, pesticides, herbicides etc on subsidized prices on credit to benefit cane growers.

2. Bio-fertilizers unit

Sugar cooperative society has bio-fertilizer laboratory which produces bio-fertilizers like Acetobactor, Azotobactor, PSB culture, Decomposing culture, Tricoderma, EM solution etc. Bio-fertilizers are important for protecting soil health as sugar cane is high nutrients exhausting crop. The usage of bio-fertilizers helps in biological nitrogen fixation, mobilization of phosphorus and sulpher etc. The society is providing at 15% subsidy to promote its usage by farmers.

3. Vermi compost (press mud based)

The unit is not financed by NABARAD or covered under NPOF scheme. It is a private unit owned by Warana society. The unit was established by the sugar factory by investing about Rs.20 lakh for producing almost 1200 MT per year. They started the establishment of unit in 2003. But, it started functioning from January, 2004 at the capacity of 550 TPA. Mr. Chetan Gore, who is the architect and current supervisor of this project, is a well educated person having good experience in producing vermi compost from the wastes of sugar factory.

Infrastructure and raw materials

The unit has 46 steel framed beds each with a capacity of 2 MT compost productions in every 45 days. The rate of recovery was 25-30 per cent. These beds are placed in open place but they have a shed for keeping the finished product. The unit has all necessary facilities like raw material availability, seed stock, water supply, store room, transport vehicles and packing machinery. The raw materials using in the production are press mud, cow dung, sugar cane leaves etc. The unit is running with most updated technology. The worms are very healthy and long. Worms are maturing in 6-8 weeks and the multiplication rate is more than 3 times in six weeks. They run the unit for 10 months in a year because difficulties of vermi-compost production during the rainy season. During the slack season, they are preserving the seed stock. Seven fixed labor are working in the unit including three women.

Manufacturing process

The raw materials that are using in the unit are mainly coming from the sugar factory. They purchase the press mud at the rate of Rs. 100 per MT if it is wet and Rs. 200 per MT if it is dry. The cow dung is available at Rs. 400 per MT whereas sugarcane waste is available at Rs. 50 per MT. The collected inputs are kept at a place for 15 days and then mixed thoroughly. They also add some bacterial cultures for quick decomposition. The steel frames are filled with mixed materials along with worms for producing compost. On an average, each production cycle takes 45 days for final compost production. Later, they sieve the compost and packed it 50 kg bags.

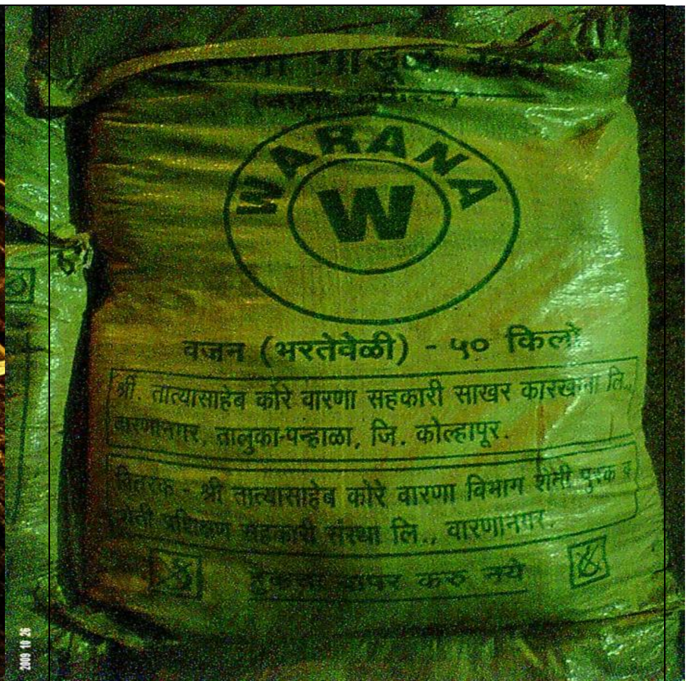
Marketing

The unit is producing good quality vermi compost and selling it under the brand name of 'Warana'. Nearly 90 per cent of their production is sold back to the sugar factory, who buys it at Rs 1800 per MT. In turn, the sugar factory is selling the compost to its society members to improve their soil quality and fertility at Rs 2500 per MT, which is comparatively cheaper than the market price. The unit also do direct marketing to farmers/non-members of society. But, only 10 per cent of their total production is marketed through this way.

Summary details about 'vermi-compost unit'

Installed capacity	1200 TPA
Current production	552 TPA
Capacity utilization rate	46 per cent
Financial Bank	Established by Warana Society
Status of JMC	Not applicable
Status of final subsidy	Not applicable
Rate of Interest	Not applicable
License/FCO	Obtained
Working days per annum	240 days
Recovery rate	25 per cent
Gestation period per cycle	45 days (6 cycles per annum)
Raw materials cost	Rs.100 per ton of wet press mud
Cost of production per kg	Rs.1.80
Method of marketing	Through society and direct
Rating for market demand	Very good
Opinion about the NPOF scheme	Not applicable

Steel framed vermi compost bed



Packed compost, ready for sales

Cost and returns from vermi-compost production unit (Rs per annum)

Item	Amount
Raw material costs	3.56
Cost of worms	1.84
Labor costs	2.70
Water costs	0.50
Packaging costs	1.32
Marketing and transport costs	0.00
Rents, taxes, insurance if any	0.10
Repairs and maintenance	0.50
Interest on working capital #	1.20
Total costs	**11.72**
Compost production (Qtl)	5500
Returns from	
a. Compost sales	13.80
b. Worms sales	2.50
Total returns	**16.30**
Net returns	**4.58**
COP of vermi-compost (per qtl)	**213.0**

@ 12 per cent per annum

The results clearly lend support for production of vermi-compost from press mud in Maharashtra. The unit costs of production are more or less equal from press mud as well as dung based vermi-compost units. The unit gained a net profit of Rs.4.58 lakh per annum. The profits of the unit would increase further with increase in capacity utilization and efficiency.

Problems/suggestions

Shortage in power supply and absence of favorable atmosphere during rainy season for vermi-compost production are the major setbacks for the unit. Mr.Gore opined that the demand for organic manures can be further improved by conducting more awareness programs and field demonstrations. He also said that their unit is looking for financial support for further expansion in production. He expressed that integrated usage of organic and inorganic fertilizers will increase the productivity of sugarcane without damaging the soil, eco-system and natural resources.

High quality and low cost production of vermi-compost by using press mud are the major reasons for high demand. Moreover, they are marketing in the trade mark of 'Warana' through warana bazaars giving more impetus for easy marketing. Growing awareness of farmers about soil health and sustainable production techniques is further boosting the use of organic fertilizers in this region. However, to generate more profits in the production of compost, the unit has to increase its current capacity utilization and scales of production. Since availability of raw materials is not a constraint in the production, the society should think about some high end technology for massive production of compost in this region.

4. Warana cooperative 'Dudh Sangh'

Warana dairy is one of the most successful cooperative dairy in India. Established in 1968, it was initially operating in around 66 villages and sending the milk to Miraj. Later in 1974-75 they established their own dairy and milk processing unit and started marketing milk, butter and ghee to Mumbai. They have now set their own cold storage and processing unit at Navi Mumbai as well. The dairy is an ISO 9001-2000 organization and its ghee got quality of 'AGMARK'. Their annual turnover is now as high as Rs. 460 crores. The processing units' capacity is about 10 lakh liters per day.

5. Warana cooperative bank

Warana cooperative bank, "a big bank of small people", was established in 1966. So far, it has got 24 well equipped and computerized branches with Rs. 140 crore fixed deposit, Rs. 85 crore loan disbursements and Rs. 2.8 crore as a share capital.

6. Warana Bazaar

This is the first cooperative departmental store in India. This was established in 1976, with 50 branches, 2 departmental stores and 6 franchises units. Today, the turnover is more than Rs 90 crore. About 78 per cent shareholders of the Warana Bazaar are women. It caters all kinds of needs of rural customers.

Like this, they are infinity number of activities under one roof called ‘Warana’. Tatyasaheb Kore was a Great visionary leader with an in depth understanding of poor economic status of farmers in this region. Initially, he started with establishment of sugar cooperative and formed strong market linkages for cane growers. Later, he has given equal weightage for the developed of agri-allied cooperative such as milk cooperative and poultry farms. To improve the socio-economic status and savings of the farmers, he has formulated Warana cooperative bank. He has also given more emphasis on sectors like education, health, women empowerment etc. All these initiative paved the way for integrated development of the society and welfare of the poor.

****

Chapter VI

Marketing of organic inputs in India

Input marketing is growing at a rapid rate in India. Besides rational output/input pricing, there is an urgent need to effectively meet the increasing and changing requirement of various inputs in agriculture. In the recent past, the use of agricultural inputs has not only increased but certain structural changes in use of different inputs have also been noticed (Chauhan, 1992). It is felt that the increasing reliance of farmers on purchased inputs makes him vulnerable to breakdown in delivery of such inputs and their supply restriction or fluctuations in their cost. In this context management of agricultural input supply chains assumes greater importance. So, effective distribution and management of marketing channel hold the key to commercial success in any industry, but much more so in the agricultural input industry (Bhargava, 1992).

Major thrust in the policy areas is to be laid on the problems of marketing and finding solution to such problems through relevant marketing facilities. If the marketing activity is developed, demand for goods increases, as a result, production of goods also increases. Due to increased production, the demand for inputs increases i.e., the demand for input is derived from the increase in demand for the output. If the supply of these inputs is ensured with competitive prices, quality and time, without any risk involved, the needs and desires of farmer will satisfy. This is possible only when the markets are efficient in supplying the needed inputs to the farmers. Hence, efficient marketing system would always brings welfare to all those involved in the system (Acharya and Agarwal, 2008). So creation of an efficient marketing system for marketing of organic inputs is the need of the hour for strengthening the organic farming in the country (Singh, 2004; Ghosh, 2004). Thus, this chapter briefly covers the major channels used by promoters for marketing of their organic inputs in the study area, problems in procurement and usage of different organic inputs and issues in marketing of organic inputs.

Ghosh (2004) studied the promotion of bio-fertilizers market in India and concluded that there has been no accelerated growth in distribution as well as inadequate spatial diffusion across states. The study also highlighted that about 90 per cent of its usage restricted to Western and Southern regions. Finally, the paper argued that the government has ample grounds to intervene to set up an effective market for bio-fertilizers, while encouraging private players. But the policy and instruments of intervention need to be designed with care. For greater farm level acceptance of organic inputs, the study gave various suggestions to the Government.

6.1 Channels for marketing of organic inputs

This section specifically emphasizing about the different marketing channels exists in sample vermi-compost units covered in the study. More or less, the situation is same in the rest of India. Almost all units were following direct sales method rather than depending upon any other intermediary. In very few cases, units were linked up with local dealers and sales representatives. But, the share in total sales was very high in direct sales (almost 60-80 per cent). In general, the sample units are using the following three basic channels for marketing of organic input i.e., vermi-compost.

Channel 1:

Producer → Organic farmer

Channel 2:

Producer → Local Dealer/Distributor → Organic farmer

Channel 3:

Producer → Dealer/Distributor at distant market → Organic farmer

Channel-1 represents the direct marketing of vermi-compost producers to organic farmers, green houses, nurseries and orchards etc. This was major marketing channel among the three different types. This channel was exists in all the four sample states. It accounted for lion share (70%) in the total product marketed. This way of marketing is taking place basically by his local contacts with different people and his network in neighboring villages. Faith or trust on the vermi-compost producer plays a crucial role in this channel. But, the main problem in this channel was sales on credit basis. The producer has to rely on the organic farmer/nursery person for his payment till he markets his product. So, producer has to investment first and waits for his returns. Sometimes, the waiting period varies from 4 to 12 months. Since many of the producers belong to medium and large land holding categories, they can sustain to some extent of time delay. However, it is burdening the producers when marketing it directly. Most of the product marketed through this channel was non-licensed/certified.

Channel-2 depicted that an entry of one middleman in the direct marketing between organic input producer and organic farmer. These local dealers/distributors are basically involved in regular marketing of fertilizers/pesticides in the villages. They were asking the vermi-compost producers to fill the final product in their bags which contains dealer's trade name or mark on it. Later, the dealer sells the product on his own trade mark or name to organic farmers in different villages. The maximum coverage by a dealer/distributor will be around 10-15 villages or one taluka. Here, the influence of dealer/distributor plays a major role in marketing of the compost. But, local dealers/distributors were paying very low price to vermi-compost producers. However, the sales in this channel are also on credit basis. Overall, the producer to some extent will reduce his marketing risk by loosing some margin in sales. The quantum of total product marketed through this channel was around 20 per cent. The type of product marketed through channel was also mostly non-certified. This channel was operating in Gujarat, Maharashtra and U.P states.

The slight difference between Channel-2 and Channel-3 was the location of the dealer/distributor. In case of Channel-3, the dealer/distributor operates the marketing transactions from distant place. The vermi-compost producer will export his product to the distant dealer/distributor where they have good demand/market. The distributor/dealer in that place helps in marketing the product there. Here, the producer has good chances to reap premium prices for his product provided the quality is high. Normally, the quantity of product marketed through this channel was very low (10 per cent). This mode of marketing was prevalent in U.P than in the remaining states. The reason was the proximity to nation's capital and export channels making it more advantageous for U.P state. However, the problem in this channel was certification of the product. Some private labs and brokers taking this as advantages and getting 5 to10 per cent share in the total returns.

Nature of market demand

The nature of market demand in the vicinity of organic input units in the sample states were asked during the field visits. The summary of answers is presented in table 6.1. The sample organic units were classified in to three categories based on the existing market demand for organic inputs in the surrounding villages. Overall, 32.5 per cent of units rated it poor demand for vermi-compost in their villages. Half of the study units classified the markets as average. Only 17.5 per cent of promoters expressed it as good demand for their vermi-compost in the villages. In case of Gujarat, nearly half of the sample units categorized under poor demand while remaining half as average. All the promoters in Punjab expressed that the market demand as average. Out of the four units in Maharashtra, two each were classified under average and good demand markets. The total sample units in U.P were labeled in to seven, five and five respectively for poor, average and good market demand.

Table 6.1 Classification of input units based on market demand (no.)

Quarter	Gujarat	Maharashtra	Punjab	Uttar Pradesh	Overall
Poor	6	0	0	7	13 (32.5)
Average	7	2	6	5	20 (50.0)
Good	0	2	0	5	7 (17.5)
Total	13	4	6	17	40 (100.0)

Note: Figures in the parenthesis indicates percentage to total

Intensity of market demand

The distribution of market demand across different quarters in a year is presented in table 6.2. The market demand in sample states were rated across four quarters in a year. It clearly indicates that there is no uniformity in market demand across states. These differences were even conspicuous within region. It concludes that the market demand depends upon a wide range of factors i.e., choice of crop, soil nature, crop management practices etc.

Table 6.2 Market demand over four quarters (ranks)

Quarter	Gujarat	Maharashtra	Punjab	Uttar Pradesh
First quarter (Jan-Mar)	3	3	1	4
Second quarter (Apr-Jun)	1	4	3	3
Third quarter (July-Sept)	2	1	2	2
Fourth quarter (Oct-Dec)	4	2	4	1

The peak demand for vermi-compost in Gujarat was observed in second quarter of the year. The farmers in Gujarat might be more interested to apply vermi-compost during land preparation period (before kharif season). The highest market demand in Maharashtra was noticed during third quarter of the year. The farmers in Maharashtra also showed interest in application of vermi-compost just before taking up the kharif crops. In case of Punjab, Jan-March was listed as a top priority. This may be due to more usage during winter Wheat crop. Similarly, for U.P, fourth quarter as the choice for maximum consumption. The start of ratoon crop of sugarcane or wheat crop may be reason for higher demand.

6.2 Problems in procurement and usage of organic inputs

To elicit the information about the problems in procurement and usage of organic inputs, about 15 organic farmers per state (a total of 60 farmers) were interviewed during field visits. The detailed information on awareness, purchase source, timely availability and quality of organic inputs were collected through structured questionnaire. The major four inputs like seeds, vermi-compost, bio-fertilizer and bio-pesticides were covered in the study. The input-wise details were summarized and presented in tables from 6.3 to 6.5.

Seeds

Most of organic farmers are growing desi or local varieties of crop seeds. Initially, they borrow from fellow organic farmers or NGOs in their region. Later, they preserve their own seeds for future needs. Nearly 70 per cent of the sample farmers are self-reliant on seeds. In case of Gujarat (25 per cent), all sample cotton organic farmers in Kutch district are getting seeds from Agrocel Industries Ltd every year. The remaining 5 per cent sample farmers buy from market or state agricultural department. Around 88 per cent of the total sample farmers expressed that they don't have any problem in getting seeds timely. Only 12 per cent of sample farmers said they are facing problems in timely availability of seeds. 54 out of 60 sample farmers are satisfied with the quality of seeds available. Approximately 10 per cent sample organic farmers are not happy with the quality of seeds. In many cases, the costs of organic seeds (desi) were lower when compared with hybrid seeds of the same crop. Overall, the sample organic farmers did not express any specific problem in procuring the seeds across the four study regions.

Vermi-compost

The summary of responses of sample organic farmers across different states on procurement of vermi-compost is presented in table 6.3. Almost all the sample farmers have the awareness about vermi-compost. But, many of them are not exclusively using vermi-compost to supplement the inorganic-fertilizers. They are applying it in different forms like Farm-Yard Manure (FYM), NADEP compost, bio-dynamic compost and Amruthpani, Jeevamruthpani etc (liquid manures). The major problems perceived in the study in vermi-composting are care about worms and hidden costs in its maintenance.

In case of Gujarat, usage of vermi-compost was very low (around 10%) in organic crops. Mostly farmers in Kutch district practicing NADEP compost method. Partly, they are also using neem and castor cakes provided by Agrocel Industries Ltd at subsidized prices. Nearly 87 per cent of farmers expressed that the compost is available timely. All most all the cotton growers rated quality of inputs as 'good'.

Table 6.3 Details about procurement of vermi-compost

State	Awareness (yes-%)	Purchase source	Timely available (yes-%)	Quality
Gujarat	100	Own, Agrocel store and market	87	Good
Maharashtra	100	Own, market	67	Average
Punjab	100	Own, market	93	Good
U.P	100	Own, market	67	Average

Most of sample farmers in Maharashtra are using bio-dynamic compost, Amruthpani and Jeevaruthpani etc (liquid manures). Very few farmers are also practicing vermi-compost for organic cultivation of sugarcane. Nearly, 85 per cent of their compost requirements met by own production. 10 out of 15 farmers said that the compost is available timely in the market. But, they graded the quality as 'average'. All the sample organic farmers in Punjab followed either natural farming (Amruthpani, Jeevaruthpani etc) or NADEP compost. Most of their compost production requirements are met by themselves only. The timely availability and quality of the compost is good. In case of U.P, vermi-compost, NADEP compost, Amruthpani and Jeevaruthpani are major forms of application. Here, there is a demand for vermi-compost and farmers are buying it from market as well. The timely availability and quality of it was low. Overall, the specific problems in procurement of vermi-compost are lack of organized marketing channels in the study regions. Absence of product standards and certification of compost are major hurdles. Most of the sales are based on personal faith or trust of the producer.

Bio-fertilizers

The details about procurement of bio-fertilizers in sample states are presented in table 6.4. On average, 60-80 per cent of organic sample farmers have good awareness about bio-fertilizers and their usage. The major sources for procurement are state agricultural universities and agricultural departments. Absence of organized input marketing channels is the major constraint for timely availability and quality. 87 per cent of the sample farmers in Gujarat have awareness about bio-fertilizers. They all purchase from Agrocel stores in the study region. They told that the quality of input is good. Similarly, in case of Maharashtra only 67 organic farmers are aware of it. State agricultural university is the major source for them. They expressed that the quality of bio-fertilizers are effective.

The average awareness rates are almost equal (60 per cent) in case of Punjab and U.P states. The major sources are state agricultural universities, National Horticultural Mission (NHM) and agricultural department. In general, they don't have any problem in getting them timely. But during the peak periods, scarcity occurs because of absence of established input marketing channels. Sometimes, they are facing the problem of old stocks of bio-fertilizers. Normally, six months after packing of bio-fertilizers, the effectiveness will go down. They perceive that the performance of bio-fertilizers is ‘average’. The specific problem for procurement is lack of effective distribution channels at block levels. Product standardization is very poor and there are no checks for adulteration.

Table 6.4 Details about procurement of bio-fertilizers

State	Awareness (yes - %)	Purchase source	Timely available (yes-%)	Quality
Gujarat	87	Agrocel store	87	Good
Maharashtra	67	Agril. Univ	80	Good
Punjab	60	PAU, NHM, Agril-Dept	74	Average
U.P	60	Univ, Agril-Dept, Private company	87	Average

Bio-pesticides

The procurement information about bio-pesticides among organic farmers is presented in table 6.5. On whole, 70 per cent farmers have awareness about bio-pesticides. But, most of them mainly aware of neem oil, bramhastra and agniastra etc (natural pesticides). Almost all the farmers prepare these pesticides by themselves and apply. But, use of bio-pesticides like Trichoderma viride, Pseudomonas, Beauvaria, Verticillium and Bacillus are limited. Very few farmers in the sample have exposure about them. In case of Gujarat, organic cotton farmers are dependent on Agrocel for neem oil. Presence of some private companies who produces bio-pesticides and natural plant growth regulators was observed in case of Punjab and U.P states. But, very few farmers are using them or under process of trials. Overall, the organic farmers are happy about the results of bio-pesticides. There are no specific problems in procurement of bio-pesticides in the study area.

Table 6.5 Details about procurement of bio-pesticides

State	Awareness (yes - %)	Purchase source	Timely available (yes-%)	Quality
Gujarat	87	Own, Agrocel store	87	Good
Maharashtra	80	Own, private	100	Good
Punjab	74	Own, private	87	Good
U.P	60	Own, private	87	Good

Problems in usage of organic inputs

Absolutely, organic farmers did not face any problems in usage of seeds. But, the preservation, multiplication and accessibility of local varieties should be made through local research centers or state agricultural universities. Many organic farmers practicing mixed cropping systems for biological fixation of 'N' in the soil. They are also growing boarder crops or live fence plants for the control of pests' attacks. In case of vermi-compost, the sample farmers did not express any problems in its usage. The real problem is about its efficacy in farmer's field. The farmers are not able to judge its efficiency by seeing it physically. So, product standardization and certification should be made mandatory for marketing. Very few farmers are experiencing the problem of micro-nutrient deficiency (zn, mn, fe etc) when they turned from conventional to organic farming, especially in case of orchards.

Farmers are really looking for more awareness/training programs in case of usage of bio-fertilizers. The quality of bio-fertilizers is always questionable? Strict supervision and monitoring are needed for implementation of production standards and efficacy of bio-fertilizers. Most of the botanical pesticides are prepare by farmers themselves. The main problem is in its application. Most of the botanical pesticides can only be applied through manual sprays due to their sticky nature. It takes lot of time for farmers to apply in his entire field. Thus, refinement of botanical pesticides to spray through power sprays would help the farmers very much. Similarly, more awareness and training programs are needed for the usage of bio-pesticides like Trichoderma viride, Pseudomonas, Beauvaria, Verticillium etc.

6.3 Issues in marketing of organic inputs

Nearly half of the sample promoters expressed that they are facing severe marketing problems in marketing of the vermi-compost. As the earlier results summarized, the demand for vermi-compost was low in the villages. Promoters were trying hard to market their output. Many times, farmers were succeeded to market only a fraction of output. Even in some extreme cases, they were applying to their own fields/crops. In most of these transactions, the sales were on credit basis. Promoters were not able to get the returns in time. The delay in payments, some times raises the question of long term sustainability of the units. Due to low demand from the market, the buyers were offering very low prices for vermi-compost. The total gross returns from vermi-compost unit were not meeting the total costs. Actually, many of the promoters were incurring most of their family labor in the production of vermi-compost. But, if we quantify all those contributions, it is not a viable proposition. There were many hidden costs in the vermi-compost production system. At the same time, absence of proper market channels exacerbates the situation. Even though the government formulated specific standards for some organic inputs, but lack of their implementation ruin the market. It's giving an opportunity for adulteration of organic inputs in the market. Lack of proper licensing and certification system was discouraging many promoters to export their organic inputs. Finally, the government or NABARD should come up with a plan to backend the sales of compost/organic inputs.

****

Chapter VII

Economics and Efficiency of Organic Farming in India

Organic farming systems have attracted increasing attention over the last one decade because they are perceived to offer some solutions to the problems currently besetting the agricultural sector. Organic farming has the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources and improved food quality. Some countries like Europe have recognized and responded to these potential benefits by encouraging farmers to adopt organic farming practices, either directly through financial incentives or indirectly through support for research, extension and marketing initiatives. As a consequence, the organic sector throughout Europe is expanded rapidly (24% of world's organic land). But, in the developing countries like India, the share is around 2 per cent only (included certified and wildlife). There is considerable latent interest among farmers in conversion to organic farming. However, some farmers are reluctant to convert because of the perceived high costs and risks involved. Those who have converted earning equal incomes to their conventional counterparts, if premium markets are exist for organic produce. Despite the attention which has been paid to organic farming over the last few years, very little accessible information actually exists on the costs and returns of organic farming. So, this chapter made an assessment on these issues in different states of India. A brief profile of organic farmers was also discussed in this chapter.

Sample coverage

As described in Chapter IV, the study has chosen a random sample of fifteen organic farmers per state. Thus, a total of 60 organic farmers were interviewed thoroughly regarding socio-economic details, cropping patterns, costs and returns of major crops and problems in organic inputs usage etc. Similarly, a random sample of fifteen conventional farmers was also interviewed per state in the same vicinity for crop economics data. A well designed questionnaire was developed, pre-tested and administered to these sample farmers. The distribution of sample farmers in different states is presented in table 7.1.

Table 7.1 Distribution of organic sample farmers

State	Gujarat	Maharashtra	Punjab	Uttar Pradesh
District	Kutch	Sangli and Kholhapur	Faridkot and Fatehgarh Sahib	Saharanpur and Muzaffarnagar
Taluka	Rapar	Walwa, Panahala, Hatkangale, Karver	Jaito, Fatehgarh Sahib	Gudamp, Thana Bhawan, Titron
Villages	Kedianagar, Bhutakya, Padampar	Chikurde, Kodali, Nilewadi, Talasande, Kerli, Bhuyewadi	Dabrikhana, Chaina, Randhawa, Badhou Chikalan, Satabgarh	Gudamp, Thana Bhawan,Nabada, Bhaneda Udda, Gagor

The sixty organic farmers identified for the study from four states were completely organic farmers. Most of them were totally transformed and adopting in their entire farm land. But, a fraction of sample farmers were doing it strictly in piece of their farm land. However, all the farmers were following organic practices in all crop rotations or through out the year. The organic farming methods are varying from state to state and place to place. Farmer convenience, resource availability, family labor participation and premium prices for the crops were the most influencing factors in adopting the organic farming.

The details of socio-economic profile of sample organic farmers are summarized in table 7.2. The primary occupation of the most of sample farmers (96%) was agriculture. Nearly 60 per cent of the sample farmers were dependent on livestock for their secondary sources of incomes. About one sixth of sample relies on business while almost the same proportion also does service jobs for their additional incomes. Overall, nearly 20 per cent sample farmers were illiterate. The proportion of illiterate farmers was the highest in case of Gujarat when compared to other states. Most of the farmers (43.3%) had only primary education i.e., up to 10th class standard. About three fourths of organic farmers were members' in different village committees/organizations. Most of the farmers in Gujarat were members in Fair Trade Cotton Growers Association at Rapar. The average size of the family was the highest in Maharashtra while it was the lowest in case of Gujarat. Most of the sample farmer families in Maharashtra are joint in nature where as they are nucleated in case of Gujarat state. The size of average land holding was the highest in Punjab followed by U.P, Gujarat and Maharashtra. The size of land holding was low in

Maharashtra when compared with other three states. The nature of soil in Kutch region was sandy with limited ground water irrigation potential. The soils in Maharashtra are deep to medium black in nature while the soils in Punjab are mostly alluvial type. In case of U.P, alluvial, chalka and sandy soil types were observed.

Table 7.2 Socio-economic details of organic farmers (no.)

Item	Gujarat	Maharashtra	Punjab	Uttar Pradesh
Primary occupation				
a. Agriculture	14	14	15	15
b. Service	1	1	0	0
Secondary occupation				
a. Livestock	10	9	7	10
b. Business	0	5	3	2
c. Service	0	1	5	3
d. None	5	0	0	0
Education status				
a. illiterate	7	2	2	1
b. up to 10th class	8	8	5	5
c. up to degree	0	4	4	7
d. up to P.G	0	1	4	2
Other position if any				
a. Yes	13	11	10	11
b. No	2	4	5	4
Avg. family size	6.0	12.6	7.9	10.2
Avg. land holding (acre)	16.8	7.8	28	18.8
Soil type	Sandy	Black and chalka	Alluvial and black	Alluvial, red and sandy

The nature of cropping patterns in the study region is presented in table 7.3. The nature of agriculture in Kutch region of Gujarat is cultivation of irrigated–dry crops. The sample farmers grew either cotton sole or castor sole or cotton+ castor inter crop in kharif season. During rabi season, they go for either cumin or sesamum crop. Most of the farmers in this region buy all types of crop inputs from Agrocel Industries Ltd. In case of Maharashtra, sugarcane was the major crop observed in the sample farms. They also practice either paddy-wheat or paddy – vegetable crop rotations. Most of the sample farmers self-sufficient and did not depend on outside market for organic inputs. Paddy followed by wheat is the most prominent cropping system found in Punjab sample farms. Sometimes, they also rotate paddy with vegetables like cubbage, cauliflower, potato etc based on the market demand. Sugarcane was also a major crop in Uttar Pradesh state. Paddy – wheat or paddy – mustard cropping systems were the other common crop rotations.

Table 7.3 Summary of cropping patterns in the study area

Item	Different Crop rotations
Gujarat	Cotton + Castor – sesamum Cotton – Cumin Castor – Bajra
Maharashtra	Sugarcane Paddy–wheat Paddy –vegetables
Punjab	Paddy – wheat Paddy – vegetables Cotton- wheat
Uttar Pradesh	Sugarcane Paddy – wheat Paddy –mustard

7.1 Economics of organic farming vis-à-vis conventional farming

7.1.1 Brief review of literature

Lampkin (1994) summarized various studies conducted on economics of organic farming in different crops in South and West of England and parts of Scotland and Wales. They concluded that the organic farming systems were more diverse in terms of enterprise mix; have lower yields and higher labor costs which were not compensated for fully by reduced input costs. Higher prices are essential if organic farmers are to achieve similar incomes to their conventional counterparts.

Padel and Uli (1994) reviewed several studies on costs and returns of organic farming in various crops in Germany. Their study revealed that the organic farming under German conditions was equally profitable with conventional farming. Lower yields for arable crops were compensated by reduced costs of inputs and premium prices for most the crops. Many farmers' explained that financial stability was the main reason for converting to organic farming. Introduction of support scheme for conversion and continuing organic farming also made a significant impact on the profitability.

Dubgaard (1994) studied the economic analysis of organic farming in Denmark. His results showed that the yield differences were most noticeable for intensive crops such as wheat and potatoes with organic yields around half the conventional averages. The organic farms used about twice as much labor per hectare as the conventional farms. The study also concluded that the substantial price premiums on output and public support are essential for the economic viability of organic farming in Denmark.

John (1994) reviewed the various field experiments conducted on organic farming in Canada. Many sample farms recorded yields that were the same or slightly below conventional farms. Even though some market regulatory problems exist in case of organic products, the prices for them were higher (about 30%) than the conventional products. Overall, the study concluded that 72 per cent of farmers strongly convinced that 'organic farming is as profitable as conventional'.

Anderson (1994) examined different research studies conducted on organic farming in USA. They concluded that the lower yields on organic farms contrasted with conventional farms were balanced by lower production costs. The noted differences between economic performances of organic and other farms may be due to farm size rather than farming system. During the study period, the US organic producers did not receive any benefit from the environmental advantages except to the extent that consumer willing to support by paying a premium.

Wynen (1994) carried out a review study on organic farming in Australia. He concluded that the wheat yields were almost similar between organic and conventional farms. The study also indicated that the variability of wheat yields on organic farms was lower than on conventional farms. The financial results of two groups of farmers per hectare were remarkably similar.

Singh *et al* (2006) examined the economics of organic farming in Uttaranchal (India) and concluded that cultivation of paddy yielding more profits than wheat cultivation. Shirsagar (2008) studied the impact of organic farming on economics of sugarcane cultivation in Maharashtra (India) and concluded that the yields were low in organic farms than conventional farms but compensated by price premiums. Raj kumar

(2009) analyzed economics of carrot cultivation in Nepal and found that higher costs and revenues in inorganic farms while higher benefit cost ratio was observed in organic farms.

From review of various studies, it can be concluded that absolutely yields are lower, but yield differences relative to conventional systems vary depending on the enterprise and intensity of farming. The cost of variable inputs like agrochemicals was lower. Gross margins may be similar or higher depends on premium prices available in the market. Usage of labor was higher and other fixed costs were similar.

Economics of paddy (basmati) cultivation in Punjab

The per acre economics of paddy cultivation in Punjab state is presented in table 7.4. The primary data on cost of cultivation of paddy (basmati) under organic and conventional farming were collected in Faridkot and Fatehgarh Saheb districts during November, 2009. Most of the sample organic farmers in this region are following the concept of 'Natural farming' or 'Zero-budgeting'. The cost of production (variable) per quintal of paddy was Rs.701 under organic farming (OF) where as Rs.427 in conventional farming (CF). It is almost 64 per cent higher in OF than CF. The average cost of cultivation of paddy in OF was Rs.9325 per acre while the same in CF was Rs.7818 per acre. The cost of cultivation was nearly 19 per cent higher in OF when compared to CF. The average yield per acre of paddy was 13.35 and 18.36 quintals respectively in OF and CF. The absolute difference between the yield levels was 5.01 quintal per acre. But, the unit price of paddy was higher (30 percent) in OF relative to CF. There was no significant unit price differences in fodder prices. The average net returns per acre of paddy cultivation were Rs. 17828 and Rs.20897 respectively in OF and CF. However, the differences between the gross returns per acre of these farming were marginal (Rs.1562 only).

Among the different cost break-ups, the real costs on weeding and harvesting operations were significantly higher in OF when compared to CF. It clearly indicates the more labor incentive nature of OF than CF. The relative costs on fertilizer application was higher in OF while the same on plant protection was higher in CF. The marketing costs were higher under organic paddy because they have to carry product to specific mandi rather than local mandi for fetching the premium prices.

The costs on the remaining cost items were more or less equal in both types. Since, the organic farmers were practicing organic methods from two or three years, it takes some more time to stabilize or increase the yields further under organic farming. The premium prices for paddy helping the organic farmers in Punjab to cover their higher costs to some extent.

Table 7.4 Economics of Paddy cultivation in Punjab (Rs per acre)

	OF	CF	CF=100
Land preparation	1265	1307	97
Seed cost	320	279	115
Sowing cost	1790	1815	99
Fertilizer cost	1955	1760	111
Inter cultivation/Weeding	1245	471	264
Plant protection cost	310	928	33
Irrigation cost	310	72	431
Harvesting cost	1180	771	153
Threshing cost	510	300	170
Marketing cost	440	115	383
Other costs	0	0	-
Total cost of cultivation	9325	7818	119
Yield (Kg)	1335	1836	73
Price (Rs)	19.5	15	130
Fodder (Qtl)	11.2	12.5	90
Price (Rs)	100	94	106
Total revenue	27153	28715	95
Net returns	17828	20897	85
Cost of production (per Qtl)	701	427	164

Economics of wheat cultivation in Punjab

The comparison of cost of cultivation of wheat between organic and conventional farming methods in Punjab is presented in table 7.5. The costs and returns on wheat data pertains to cropping year 2009-2010. Most of sample organic farmers in the state were cultivating ‘Bansi’ (local) variety of Wheat. The cost of production per quintal was Rs.644 under OF. But, the same in case of CF was Rs.315. The cost of production per quintal of wheat was more than double in OF. It was due the lower (nearly half) yields under organic farming. But, the overall cost of cultivation per acre was slightly higher (17 per cent) in OF when compared to CF. The market price realization of per kg wheat was significantly higher in OF (117 percent). However, the gross returns per acre of wheat cultivation in Punjab were Rs.28747 and

Rs.24755 respectively for OF and CF. This indicates almost 16 per cent higher gross returns per acre of wheat under OF over CF. However, the per acre net returns difference between OF and CF was Rs.2889. It clearly shows the high profitability of wheat cultivation under organic farming in Punjab. As the organic farmers gains more experience under OF, higher yields can be expected on par with CF.

Among the different crop operations, the higher costs under organic farming were observed in weeding, harvesting and threshing. Most of sample organic farmers are following manual harvesting and threshing practices for good quality of wheat grains and straw. Due to that the costs on labor per acre was higher under OF. The costs on fertilizers and plant protection chemicals were significantly higher under conventional farming. The lower fodder yields were noticed under OF because of lower yields. Overall, there is huge potential for domestic as well as export of organic wheat from Northern states.

Table 7.5 Economics of Wheat cultivation in Punjab (Rs per acre)

	OF	CF	CF=100
Land preparation	1050	1010	104
Seed cost	1240	1285	96
Sowing cost	275	261	105
Fertilizer cost	1163	1520	77
Inter cultivation/Weeding	1350	495	273
Plant protection cost	92	435	21
Irrigation cost	142	130	109
Harvesting cost	1300	840	155
Threshing cost	710	330	215
Marketing cost	217	130	167
Other costs	0	0	-
Total cost of cultivation	7539	6436	117
Yield (Kg)	1170	2042	57
Price (Rs)	22.3	10.3	217
Fodder (Qtl)	11.4	16.4	70
Price (Rs)	233	227	103
Total revenue	28747	24755	116
Net returns	21208	18319	116
Cost of production (per Qtl)	644	315	204

Economics of cotton cultivation in Punjab

The details of economics of organic cotton farming vis-à-vis conventional farming are summarized in table 7.6. The costs and returns of cotton cultivation from sample organic as well as conventional farmers were collected during the cropping year 2009-2010. Many of the sample organic farmers were cultivating desi variety of cotton where as conventional farmers were growing Bt cotton varieties. The cost of production per quintal of cotton under OF was Rs.662 while the same in case of CF was Rs.1112. The cost of production in OF was almost 40 per cent lower than CF. The average cost of cultivation per acre of cotton were Rs.5427 and Rs.12455 respectively under organic and conventional farming. There is a huge difference of Rs.7028 (66 %) between these farming types. The mean yield per acre of OF was 73 per cent of conventional farming. The unit price realization of cotton was almost same under both production systems. Total gross returns per acre of organic farming were 72 per cent of conventional farming. But, in case of net returns per acre, the share increased to 90 per cent. The average differences between the OF and CF net returns per acre was Rs.1935. It clearly demonstrates the high potential of organic cotton farming when compared to conventional farming in Punjab.

Table 7.6 Economics of Cotton cultivation in Punjab (Rs per acre)

	OF	CF	CF = 100
Land preparation	967	850	114
Seed cost	125	1250	10
Sowing cost	150	125	120
Fertilizer cost	333	2250	15
Inter cultivation/Weeding	1332	650	205
Plant protection cost	33	4550	1
Irrigation cost	380	150	253
Harvesting cost	1967	2500	79
Threshing cost	0	0	-
Marketing cost	140	130	108
Other costs	0	0	-
Total cost of cultivation	5427	12455	44
Yield (Kg)	825	1125	73
Price (Rs)	28	28.5	98
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	23100	32063	72
Net returns	17673	19608	90
Cost of production (per Qtl)	662	1112	60

Among various cost components, inter cultivation /weeding and irrigation costs were higher in organic farming. But, the costs on seeds, fertilizers and plant protection chemicals were significantly higher in conventional farming. Actually, the major problem for organic cotton farming was lack of premium prices. Establishment of organic cotton export channels either by government or private organization would really enhance the incomes of the farmers in Punjab. The results clearly reveal that the organic farmers can safely earn almost equal amount of net margins per acre as conventional farmers.

Economics of paddy cultivation in Uttar Pradesh

The costs and returns of paddy (basmati) cultivation both under organic and conventional farming types are presented in table 7.7. The primary data on sample organic and conventional paddy cultivation was collected from Ahmednagar district of Uttar Pradesh pertains to the cropping year 2009-2010. Most of the sample organic farmers are practicing the method of 'Natural farming' or Zero-budgeting concept in their farms. The most common basmati varieties growing in this region are Pusa – 1 and Pusa -1121.

Table 7.7 Economics of paddy cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	3482	3444	101
Seed cost	501	511	98
Sowing cost	1136	1400	81
Fertilizer cost	1082	930	116
Inter cultivation/Weeding	622	375	166
Plant protection cost	350	521	67
Irrigation cost	2281	3300	69
Harvesting cost	2082	2214	94
Threshing cost	1555	1671	93
Marketing cost	140	80	175
Other costs	0	0	-
Total cost of cultivation	13231	14446	92
Yield (Kg)	1518	1807	84
Price (Rs)	15.8	16.9	93
Fodder (Qtl)	10.5	11.8	89
Price (Rs)	70	93	75
Total revenue	24719	31636	78
Net returns	11488	17190	67
Cost of production (per Qtl)	870	803	108

The average cost of production per quintal of paddy (basmati) under organic farming was Rs.870 while the same in conventional farming was Rs.803. The cost of production per quintal under OF was 8 per cent higher than CF. The mean yield per acre in OF accounted for 84 per cent of the conventional farming yield. The average gross returns per acre of conventional farming were nearly 28 per cent higher than organic farming. The average net returns per acre of paddy cultivation were Rs.11488 and Rs.17190 respectively for OF and CF. No premium prices were available for organic paddy in Uttar Pradesh. The yield levels under organic farming were lower (16%) than conventional farming. The fodder yields per acre were also lower in organic farming. Among different cost items, weeding cost was significantly higher in organic farming. The costs on plant protection chemicals and irrigation were significantly higher in conventional farming. It clearly indicates that organic farming increases water-use-efficiency of the farm. Lack of premium prices as well as absence of export market channels limits the expansion of organic farming in the state.

Economics of sugarcane cultivation in Uttar Pradesh

The detailed break-up of the cost of cultivation of sugarcane in Uttar Pradesh state is presented in table 7.8. Most of the sample organic farmers were growing CoS 88230 variety of sugarcane while majority of conventional growers were using CoS 88230 or CoS 767 varieties.

The cost of production of sugarcane per ton was Rs.820 under organic farming. But, the cost of production per ton was 16 per cent higher under conventional farming. The mean yield per acre was 12 per cent higher under organic farming. The average cost of cultivation per acre of organic farming accounted for 97 per cent of the conventional farming cost. The gross returns per acre of OF was 9 per cent higher than CF. However in case of the net returns per acre, this value gone up to 19 per cent. The results conclude that the cultivation of sugarcane was more profitable under organic farming than conventional farming. Premium prices did not exist for organic sugarcane production in U.P. Creation or addition of premium price would further increase the profitability of organic sugarcane production.

Among different cost components, the costs were more or less equal in both types of farming systems. One of the major benefits under organic sugarcane cultivation was the crop can thrive for more than three years without any yield loss. So, organic farmers can significantly reduce their seeds and sowing costs and reap more benefits. Production of organic jaggary or any other value addition measures would further boost organic sugarcane production in the state.

Table 7.8 Economics of sugarcane cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	2892	3533	82
Seed cost	4090	5065	81
Sowing cost	1514	1313	115
Fertilizer cost	1935	1904	102
Inter cultivation/Weeding	3113	3217	97
Plant protection cost	420	687	61
Irrigation cost	2750	2687	102
Harvesting cost	3495	2847	123
Threshing cost	0	0	-
Marketing cost	2190	1846	119
Other costs	0	0	-
Total cost of cultivation	22399	23099	97
Yield (Kg)	27364	24333	112
Price (Rs)	1.95	2.02	97
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	53360	49153	109
Net returns	30961	26054	119
Cost of production (per ton)	820	951	86

Economics of wheat cultivation in Uttar Pradesh

The economics of wheat cultivation under organic farming vis-à-vis conventional farming is summarized in table 7.9. Most of sample organic farmers were cultivating Bansi or 292 varieties of wheat. But, many conventional farmers were growing PBW-343 or WL-711 varieties. The cost of production of wheat per quintal was Rs.620 under organic farming. The same under conventional farming was slightly lower at Rs.609 per quintal. But, the average cost of cultivation per acre was lower in organic farming (8 per cent) when compared to conventional farming. The average yield levels were 1519 and 1682 kg respectively under OF and CF. However, the gross returns per acre was higher (15 per cent) in organic farming than conventional farming. This share has further gone up to 39 per cent in case of net returns per acre. The unit price realization was 28 per cent higher in OF. These results clearly demonstrate that the cultivation of wheat under organic farming is more profitable than conventional farming method.

Between different cost components, the costs on weeding and inter culture was higher in organic farming. But, the costs on irrigation were higher under conventional farming. Further expansion in green or organic export marketing channels will yield higher net incomes per acre to farmers in U.P state.

Table 7.9 Economics of wheat cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	2298	2571	89
Seed cost	1281	1034	124
Sowing cost	663	674	98
Fertilizer cost	981	1054	93
Inter cultivation/Weeding	656	432	152
Plant protection cost	85	214	40
Irrigation cost	994	1532	65
Harvesting cost	1510	1674	90
Threshing cost	844	879	96
Marketing cost	106	159	67
Other costs	0	0	-
Total cost of cultivation	9418	10223	92
Yield (Kg)	1519	1682	90
Price (Rs)	13.4	10.5	128
Fodder (Qtl)	14	13.8	101
Price (Rs)	222	193	115
Total revenue	23463	20324	115
Net returns	14045	10101	139
Cost of production (per Qtl)	620	609	102

Economics of sugarcane cultivation in Maharashtra

The cost of cultivation of sugarcane per acre in Maharashtra between organic and convention farming is compared in table 7.10. The primary data on economics of sugarcane cultivation under both the methods were collected in Warana district of Maharashtra. Most of sample organic farmers are practicing the method of ‘Natural Farming’ or Zero-budgeting concept. The most popular varieties under organic and conventional farming systems are Co-86032 and CoC-671/ Co-8014 respectively.

The cost of production of sugarcane per ton was Rs.589 in case of organic farming where as the same under conventional farming was Rs.745. The COP under OF accounted for 79 per cent of the same in CF. The mean cost of cultivation per acre was lower (20 per cent) under organic farming compared to conventional farming. The average yields were almost equal under both the farming systems. The gross returns per acre was slightly higher (8 per cent) under OF than CF. But, the difference has increased to 35 per cent in case of net returns per acre. The results clearly lend support to organic farming in Maharashtra than conventional farming. Most of the sample organic farmers are also adding value through organic jaggery production and syrup preparation. Among different break-up costs, the costs on sowing and irrigation were slightly higher under organic farming than conventional farming. But, the costs on fertilizer application and plant protection chemicals were significantly higher under conventional farming. Overall, development of export marketing channels will create lot of value addition to organic jaggery in Maharashtra.

Table 7.10 Economics of sugarcane cultivation in Maharashtra (Rs per acre)

	OF	CF	CF = 100
Land preparation	3675	4100	90
Seed cost	4825	5300	91
Sowing cost	1313	1120	117
Fertilizer cost	2344	5450	43
Inter cultivation/Weeding	3313	4300	77
Plant protection cost	275	1550	18
Irrigation cost	3588	3040	118
Harvesting cost	2375	2700	88
Threshing cost	0	0	-
Marketing cost	838	760	110
Other costs	0	0	-
Total cost of cultivation	22546	28320	80
Yield (Kg)	38375	38000	101
Price (Rs)	1.6	1.5	107
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	61400	57000	108
Net returns	38854	28680	135
Cost of production (per ton)	589	745	79

Economics of cotton cultivation in Gujarat

The detailed break-up of cost of cultivation of cotton in Gujarat is presented in table 7.11. The primary data was collected on both organic and conventional farming in Kutch district of Gujarat. Most of sample organic farmers were growing devraj variety while many of the conventional farmers cultivating Bt cotton or V-797 variety of cotton. Agrocel Industrial Limited at Rapar office is providing the technical service, inputs and buyback arrangements for organic farmers.

Table 7.11 Economics of cotton cultivation in Gujarat (Rs per acre)

	OF	CF	CF = 100
Land preparation	939	1600	59
Seed cost	206	281	73
Sowing cost	443	375	118
Fertilizer cost	1586	2675	59
Inter cultivation/Weeding	1946	1800	108
Plant protection cost	110	478	23
Irrigation cost	1161	1291	90
Harvesting cost	3515	3525	100
Threshing cost	0	0	-
Marketing cost	0	63	0
Other costs	0	0	-
Total cost of cultivation	9906	12088	82
Yield (Kg)	1263	1400	90
Price (Rs)	35	28	125
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	44205	39200	113
Net returns	34299	27112	127
Cost of production (per Qtl	784	863	91

The cost of production of cotton per quintal was Rs.784 in organic farming. The cost of production was almost 10 per cent higher under conventional farming. The mean average yield per acre of organic farm accounted for 90 per cent of the same in conventional farm. The average costs of cultivation per acre were Rs.9906 and Rs.12088 respectively under OF and CF. The COC per acre was almost 22 per cent higher under conventional farming. The unit price realization under organic farming was 25 per cent higher when compared to conventional farming. The gross returns per acre were 13 per cent higher under organic farming than the conventional farming. But, in case of net returns per acre this gap has become wider (Rs.7187).

Overall, the results conclude that the cultivation of cotton under organic farming is more profitable than conventional farming.

Among different cost components, the costs on fertilizer and plant protection chemicals were significantly lower under organic farming than conventional farming. The organic farmers in the study region were enjoying the benefits of Agrocel Industries in form of quality inputs (seeds, neem cake, castor cake and neem oil etc) and zero marketing costs. Moreover, organic farmers were getting additional subsidies from Agrocel Industries for land leveling and buying drip irrigation systems.

In general evaluation made in light of these research results concludes, organic farming is a production system which has little lower productivity per hectare, needs more labour and low energy inputs, follows crop rotation regularly, and has a changing net income level relating with product selling prices.

7.2 Efficiency of organic farming in India

7.2.1 Brief review on farm level efficiency and its determinants

Athreya V.B *et al.,* (1986) examined the controversial issue of 'farm size and productivity' in case of agricultural production in Tiruchi district, Tamil Nadu. They argued that the size-productivity framework might not be the most fruitful one for analyzing the problem of agricultural productivity. The study covered a detailed farm household economic survey of 367 households in three 'wet' and three 'dry' villages of Kulithalei and Manaparei panchayat unions of the state. They defined productivity as the market value of farm production per unit of operated area and did crop level analysis on different crops. The results of study concluded that a significant negative relationship between operated area and value of output per acre at the farm level only for the wet area, but there was no relationship in the dry ecotype. Even in the wet area, the observed inverse relationship between farm size and productivity disappeared at the crop level. The intensity of cultivation and the class status of cultivating households might be more important criteria than size. Finally, a methodological conclusion arose out of the study was ecological and historical specifications of a farm economy play an important role in the determination of productivity than the size.

Battese and Tessema (1993) used stochastic frontier production function with time-varying parameters and technical efficiencies using panel data from ICRISAT's Village Level Studies in three Indian villages namely Aurepalle, Shirapur and Kanzara, during the period between 1975-76 and 1984-85. The specifications of a linearized version of a Cobb-Douglas stochastic frontier production function with coefficients which were a linear function of time, the hypothesis that the traditional response function was an adequate representation of the data was accepted for only in Aurepalle village. The hypothesis of time-invariant technical inefficiencies was not rejected for one of the two villages for which significant technical inefficiencies exist. The hypothesis of time-invariant elasticities of the input variables was rejected for two (Shirapur and Kanzara) of the three villages. Further, the hypothesis that hired and family labour was equally productive was accepted in only one of the three villages. The technical efficiencies of individual farms exhibited considerable variation in the two villages with either time-invariant or time-varying technical efficiencies.

Good *et al.,* (1993) carried out technical efficiency and productivity growth comparisons using panel data of four largest European carders and eight of their American counterparts using three alternative estimators of Cobb-Douglas stochastic frontier production model during 1976 to 1986. They identified that the potential efficiency gains of the European liberalization by comparing efficiency differences between the two carrier groups. The reductions in inefficiency described that the amount of inputs can be decreased without altering output. Finally, they concluded that while nominal efficiency measures were fairly different across these estimators, the properties of technology and the estimation of an efficiency gap between European carriers were rather stable. Eliminating the efficiency gap brought a savings to the tune of $ 4.5 billion per year and a displacement of about 42000 workers across European industry.

Coelli and Battese (1996) investigated the factors influence the technical inefficiency of Indian farmers using a stochastic frontier production function for farm-level data on three villages, Aurepalle, Kanzara and Shirapur from diverse agro-climatic regions of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The variables considered in the model for the inefficiency effects include the age and level of farmers, farm size and the years of observation. The results indicated a significant random component in the inefficiencies effects in all three villages and that the above four factors have a significant influence upon the size of the inefficiencies of farmers in Kanzara and Shirapur, but not in Aurepalle. Farm size and year of observation were inversely related to the level of technical inefficiency in all villages whereas the effects of age and education of the farmers were found negatively related to the level of technical inefficiency in two out of three villages. They also indicated that there were significant differences in the behaviour of value of output and inefficiencies of production in different regions.

Bokusheva and Hockmann (2005) investigated the causes for production variability in Russian agriculture. They found that the production risk and technical inefficiency as two major sources of production variability. The study used a panel data of 443 large agricultural enterprises from three regions of Russia from 1996 to 2001. They concluded that the production function specification accounting for the effect of inputs on both risk and technical inefficiency was found to explain appropriately than the traditional stochastic frontier formulation. Study also found that the output variability was explained mainly by production risk. The estimates indicated that there were significant differences in production technologies in the three regions not only for the production elasticities but also for the impact of technological change. Finally, the study suggested that the future research is needed to analyze the farmers' response to production risk and their adjusting behaviour.

Olson and Vu (2007) analyzed the economic efficiency and factors explaining it among Minnesota farm households using DEA method. After studied 400 farm sample data between 1993 and 2005, they concluded that there was a considerable degree of inefficiency in Minnesota farms. On average, initial technical efficiency, scale and allocative efficiency were 0.90, 0.88 and 0.77 per cent respectively. The study also employed bootstrapping to determine the variability of DEA technical efficiency estimates and to correct for the bias inherent in the deterministic measurement. The bias-corrected point estimate of technical efficiency was 0.77. Tobit analysis was employed in the second step to evaluate factors influencing efficiency in the study. The results concluded that a higher current asset share, lower debt-to-asset ratio and higher non-farm income were associated with higher efficiency levels. Higher tenancy ratio was coupled with low technical efficiency showed improvements were needed in managing larger operations and rented properties.

Adewumi and Adebayo (2008) examined the profitability and technical efficiency of sweet potato production in Kwara state of Nigeria using stochastic frontier production function. A sample of 152 farmers cross-sectional data were collected from Oyun and Offa local government areas. The study revealed that a positive gross margin of N15, 29315 per ha. Farm size, planting material and labor inputs were significant variables having positive impact on sweet potato production while fertilizer were found to have a negative effect. The study further revealed a mean technical efficiency of 0.473. This indicates that the input usage can be increased by 52.7 per cent. The increase in educational level, farm size and contacts with extension agents have showed tendency of reducing the inefficiency in sweet potato production. Access to credit sources and membership in the associations has also shown positive and significant relation to technical efficiency. Household size was negatively and significantly correlated with technical efficiency.

Begum *et al*., (2009) studied the application of DEA to evaluate technical, allocative and economic efficiency of poultry farms in Bangladesh. The results of the study revealed that under CRS and VRS specification, on average, the farms technical, allocative and economic efficiencies were 88, 70, 62 per cent and 89, 73, 66 per cent respectively. The CRS and VRS sampled farms were 12, 30, 38 per cent and 11, 27, 34 per cent respectively, below what could be achieved. The farm households appear to be dominantly increasing returns to scale. Evaluating factors associated with efficiency suggested that farmer’s educational background, experience, training, family size, and poultry farm size were most statistically significant factors contributed to efficiency.

Ayinde *et al.,* (2009) assessed the determinants of technical efficiency and varietal-gap of rice production in Nigeria. A random sample of 675 farmers was selected from three out of six geographical zones in Nigeria. The farmers in this study were classified into three groups according to the variety of rice they planted. The three main varieties of rice planted are local (Ofada), improved (Mai-Nasara) and New

Rice for African (NERICA). The technical efficiency indices were computed using the meta-frontier approach because production varieties and technologies were expected to differ between the three varieties. This method allows the measure of the varietal-differences which is the Technology Gap Ratio (TGR). Estimates of the frontier were obtained assuming a translog functional form. Results revealed mean technical efficiency of 55%, 58% and 57% for Ofada, Mai-Nasara and NERICA varieties, respectively. Farm size, hired labour, fertilizer, seed, age, gender, household size and amount of credit are the determinants of technical efficiency of farmers in Nigeria rice production. The average values of varietal technology gap were more than 0.83 in all the varieties.

Ross *et al.,* (2009) assessed the nonparametric efficiency analysis of small-scale Bean producer farmers (both climbing and bush bean types) in North and South Kivu, Democratic Republic of Congo. Data used in this study were obtained from the survey "Visite 1: Structure du Menage et Production", which was conducted between December 2006 and May 2007. On an average, farms were 66 per cent technically efficient. The results concluded that the North Kivu bean producers have higher technical efficiency scores than South Kivu producers. Similarly, the climbing beans have higher technical efficiency scores than bush beans. The Tobit model was used to identify the correlation of efficiency to other characteristics associated with each field. Variables like age, field size showed negative relationship with technical efficiency.

It is clear from various studies that every effort to promote organic farming could be invalidated if individual farms do not reach adequate productive and efficiency levels (Lampkin and Padel, 1994; Offermann and Nieberg, 2000). This means that any policy effort in supporting conversion to organic farming needs an adequate level of efficiency of individual farms to achieve success (Tzouvelekas et al., 2002a). This would imply that organic farming must strive to be efficient both productivity and economically. Therefore, development of organic methods raises significant research questions related to productivity and efficiency. Studies on productivity are certainly relevant, but also efficiency analysis provides useful information on the convenience or otherwise of adopting organic techniques (Cembalo and Cicia, 2002). The comparative studies between organic and conventional farms, efficiency analysis is particularly suitable for assessing the farmers' relative ability in optimizing internal resources. Further more, the utilization of an efficiency estimation approach is advisable in studies aimed at providing policy indications (Coelli et al., 2002; Lovell 1995).

But, there are only a few attempts of comparing efficiency between organic and conventional production systems. Several studies were conducted by Tzouvelekas *et al.* (2001a, b; 2002a, b) on Greek agriculture. The authors used a parametric approach to evaluate olive, cotton and durum wheat farms and obtained controversial results. In the analysis on cotton farms, Tzouvelekas *et al.* (2001b) found that technical efficiency (TE), with respect to their specific technology (organic and conventional) was higher in conventional farming's favour. On the other hand, the studies on olive-growing and durum wheat-growing demonstrated the improved ability of organic farmers in minimizing inefficiency (regarding their specific technology). Oude Lansink *et al.* (2002) compared efficiency measures of organic and conventional farms in Finland. They suggested that organic producers have higher technical and sub-vector efficiencies than conventional farms in their own reference groups, but overall efficiency measures suggest that organic farms are using less productive technology. In Italy, Madau (2005) applied a stochastic frontier production model and found that conventional cereal farms were significantly more efficient than organic cereal farms, with respect to their specific technology, which counter the findings from Tzouvelekas *et al.* (2001a, 2002a). In another recent study, Larsen and Foster (2005) compared efficiency measures of organic and conventional farms in Sweden by a non-parametric technique. Their results indicate that the average efficiency scores of the organic producers are lower than the average efficiency of the conventional producers.

Fabio (2007) analyzed the technical efficiency in organic and conventional farming on Italian cereal farms. He applied stochastic frontier model to estimate technical efficiency in a sample. All the observed farms were in Sardinia and they participated in the official Farm Accountancy Data Network (FADN) during 2001 and 2002. Translog functional form of production function was applied to measure the efficiency in the farms. The likelihood test results suggested that the organic and conventional farms in the sample would lie on two different frontier production functions. The estimated TEs for conventional and organic practices are, on average, 0.902 and 0.831 respectively. This concludes that organic farmers were less efficient than conventional farmers, relative to their specific frontier technology. The conventional cereal-growing tends to be more productive than organic production and the gap between them should be interpreted as an absolute advantage of traditional farms. The results that enforcing some horizontal measures like professional training and extension services would improve the ability of organic farmers.

Cisilino and Madau (2007) compared the organic and conventional farming in Olive farms using Italian FADN database. In order to identify some of the main differences between organic and conventional farms a “distance analysis” was used. The study highlighted some of the main characteristics of those two groups of farms to better address differences in production technology, costs and revenues. They also estimated differences in efficiency and productivity between organic and conventional producers using nonparametric method. Results revealed that looking at the average values on invested areas; conventional farms’ gross production was significantly higher than the organic ones, as the net margin, as the net product and costs. The average values on total labour force instead, shown that, even if conventional farms still have higher values than organic ones, the “distance” become shorter. That means that the two groups are quite similar and that, even if organic farms still produce a lower “economic value”, they better compensate productive factors, especially in terms of labour force. The efficiency analysis found that organic olive-growing farms were more able in using their disposable resources (with reference to their own frontier), and the higher efficiency permitted them to compensate the lower productivity with respect to the conventional farms.

Bayramoglu and Gundogmus (2008) calculated the cost-efficiency between organic and conventional raisin-producing households in Turkey. They used data envelopment analysis to compute overall technical and input-specific technical efficiency measures. The data were collected from fourty-four organic and thirty-eight conventional producers determined by stratified random sampling. For each household group the average cost efficiency and technical efficiency coefficients were 0.712 and 0.862 for organic households, while 0.844 and 0.903 for the conventional group. According to the coefficients calculated for individual and different returns to scale, study concluded that conventional households are on average more efficient relative to their own technology.

Funtanilla et al (2009) evaluated the organic cotton marketing opportunity in USA. They mentioned that according to the Organic Trade Association (OTA), 2004 the annual growth of organic fiber was 23 per cent. This study was under taken on organic and conventional cotton growers in 2007 from Texas High Plains (THP) to estimate their costs and returns, technical efficiency of farms and to identify factors influencing the efficiency. The results concluded that the average sample organic farmers produced 976 lbs/acre cotton from irrigated acres, a significantly lower volume than 1395 lbs/acre cotton harvested by conventional producers under the same ecosystem. Organic cotton produced from dry land farms is about 649 lbs/acre, while 772lbs/acre were obtained by conventional producers. Dry land cotton farm yields, on average, are not significantly different across farming systems. Similarly, higher actual market prices received for organic cotton ($1.27/lb and $1.15) compared with conventional cotton prices ($0.64/lb and $0.63/lb). The gross value earned by organic farmers from cotton harvested in irrigated and dry land acreage in 2007 are $1237/acre and $743/acre, respectively. Conventional cotton farmers have made $895/acre and $489/acre from irrigated and dry land portions. On average, the estimated technical efficiencies of sample organic and conventional cotton farms were 46 % and 78%, respectively. Furthermore, investigating the variation of farm efficiency scores indicated that all conventional farmers recorded efficiency rates from 50% to 100%, while only 27% of the organic farms were in the said range. Interestingly, most organic farms (67%) were found to have an efficiency level between 30% and 50%. Experience, education, and area showed positive effect on inefficiency.

Mayen *et al*., (2010) assessed the technology adoption and technical efficiency of conventional and organic diary farms in the United States. They addressed self-selection into organic farming by using propensity score matching and explicitly tested the hypothesis that organic and conventional farms employ a single, homogeneous technology. The study utilized the 2005 Agricultural Resource Management Survey on Dairy Costs and Returns Report (ARMS) data for the comparison. Results rejected the homogeneous technology hypothesis and find that the organic dairy technology is approximately 13% less productive. However, they found little difference in technical efficiency between organic and conventional farms when technical efficiency is measured against the appropriate technology.

The objective of this section is to attempt an empirical evaluation of the technical efficiency achieved by organic farms in comparison with conventional farms, by utilizing the recently developed DEA model. Interpreting technical efficiency scores of two different methods of farming always come with an important caveat, i.e. the higher scores exhibited by one farming system with respect to the other does not indicate that the former are more efficient by some degree than the latter (Tzuovelekas, Pantzios, and Fotopoulos 2001, 2002; Oude Lansink et al. 2002). The sample farms considered in this study are facing different production technologies. As per review of various studies, higher technical efficiency score of one sample farm relative to their counterpart means that, on average, the former lay closer to their specific production frontier than the sample counterpart does with their respective production frontier. Each observation consists of the gross value of production per acre as output (Y) and costs on four inputs. They are per acre costs on seeds (X1), fertilizers (X2), pesticides (X3) and inter culture/weeding (X4). Since the costs on land preparation, sowing, irrigation, harvesting, threshing and marketing did not vary significantly among organic and conventional farms, they are not included in efficiency analysis. In-put oriented DEA model is applied in the analysis.

This type of analysis is expected to illustrate possible efficiency-associated differences between the two types of farming and provide empirical evidence, which, at least in the field of organic farming performance, is scarce or even absent. Such assessments may be useful for pointing out the overall competitiveness of the sector as well as to assist policy makers in forming suitable policies for the sector's viable development. This is particularly important, since policy decisions made in the early stages of a sector's development may decisively affect its future course.

Efficiency of Paddy cultivation in Punjab

The comparison of technical and scale efficiencies of conventional and organic farms in Punjab are presented in table 7.12. Mean technical efficiency both under CRS and

VRS models were higher in conventional farming than organic farming, relative to their specific frontiers. However, it does not indicate that conventional farms are more efficient than organic farms to the same degree, because the two practices are situated on different technology frontiers. It only implies that conventional farms operate close to their specific frontier than organic farms. Organic (conventional) farms under CRS assumption would be able to increase the efficiency by 45 per cent (12.9%) with the present state of technology, using their disposable resources more efficiently. The scale efficiency is also higher in conventional farming. These results are in conformity with the study done by Madau (2005) in Italian cereals.

Table 7.12 Frequency distribution of technical and scale efficiencies of paddy farms

Efficiency %	Conventional farming (n=7)			Organic farming (n=10)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	10	0	10
26-50	14.3	0	0	40	30	10
51-75	0	14.3	14.3	30	10	30
75-100	85.7	85.7	85.7	20	60	50
Max (%)	100	100	100	100	100	100
Min (%)	38.1	66.5	57.4	9.3	31.3	24.7
Mean (%)	87.1	93.8	91.3	55.0	77.9	70.8

Efficiency of wheat cultivation in Punjab

The frequency distribution of technical and scale efficiencies of organic and conventional wheat farms in Punjab are presented in table 7.13. The average technical (both CRS and VRS) and scale efficiencies were higher under conventional farming than organic farming, relative to their production frontiers. The frequency distribution of technical and scale efficiencies clearly indicates that most of the conventional farms were in the range between 75 and 100. But, significant sample of organic farms were distributed under less than 50 per cent category. The minimum technical and scale efficiency values were very low in organic farming when compared to conventional farming.

Table 7.13 Frequency distribution of technical and scale efficiencies of wheat farms

Efficiency %	Conventional farming (n=12)			Organic farming (n=13)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	38.47	7.69	15.38
26-50	0	0	0	7.69	15.38	7.69
51-75	33.33	16.66	16.66	15.38	0	30.77
75-100	66.67	83.34	83.34	38.46	76.93	46.16
Max (%)	100	100	100	100	100	100
Min (%)	60.5	72.2	63.6	14.8	24.4	14.8
Mean (%)	86.2	93.0	92.5	55.1	84.2	66.1

Efficiency of cotton cultivation in Punjab

The summary of technical and scale efficiencies of cotton farms in Punjab are tabulated in table 7.14. Contrary to the earlier findings, the mean technical and scale efficiencies were higher in organic farms (relative to their production frontiers) than conventional farms. Most of the sample organic farms were categorized in the range between 75 and 100 where as many sample conventional farms were between 51 and 75. The minimum technical and scale efficiency values were also more in organic farming. The results were inconformity with Oude Lansink *et al.,* (2002).

Table 7.14 Frequency distribution of technical and scale efficiencies of cotton farms

Efficiency %	Conventional farming (n= 4)			Organic farming (n= 4)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	0	0	0
51-75	75	0	75	25	0	25
75-100	25	100	25	75	100	75
Max (%)	100	100	100	100	100	100
Min (%)	58.3	-	58.3	60.3	-	60.3
Mean (%)	69.5	100	69.5	90.1	100	90.1

Efficiency of paddy cultivation in Uttar Pradesh

The mean, maximum and minimum technical and scale efficiencies of paddy farms under organic and conventional farming are summarized in table 7.15. The average technical efficiencies (both under CRS and VRS) were 80.8, 89.0 and 73.4, 87.9 per cent respectively for conventional and organic farming systems. The mean scale efficiency was 90.4 and 81.6 per cent respectively for CF and OF. The results indicate that the three efficiencies calculated in the study are higher for conventional farming than organic farming (relative to their production frontiers). It also suggests that the technical efficiency (CRS model) can be further improved by 19.2% and 26.6% respectively under conventional farming and organic farming systems. The organic farms are not able to compensate for their technical disadvantage (less productivity) with higher efficiency of input use.

Table 7.15 Frequency distribution of technical and scale efficiencies of paddy farms

Efficiency %	Conventional farming (n= 7)			Organic farming (n= 11)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	14.3	0	0	27.27	9.09	0
51-75	28.6	28.57	28.57	9.09	18.18	27.27
75-100	57.1	71.43	71.43	63.64	72.73	72.73
Max (%)	100	100	100	100	100	100
Min (%)	46.0	61.0	59.0	31.7	48.2	50.9
Mean (%)	80.8	89.0	90.4	73.4	87.9	81.6

Efficiency of sugarcane cultivation in Uttar Pradesh

The frequency distribution of technical and scale efficiencies of sugarcane farms under conventional and organic farming is presented in table 7.16. In relative terms, the mean technical and scale efficiencies of organic farms were lower than the conventional farms. There is a huge difference of technical efficiency (TE) between CF and OF. Most of conventional farms were distributed in the range between 75 and 100 per cent. In contrary, many of organic farms fell under less than 50 per cent category. The estimated TE scores suggest that production is not adequately efficient under organic farming. The results clearly indicate that there is a need for improvement of efficiency under organic farms through more technical trainings and field demonstrations.

Table 7.16 Frequency distribution of technical and scale efficiencies of sugarcane farms

Efficiency %	Conventional farming (n= 15)			Organic farming (n= 11)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	36.37	27.27	0
26-50	6.6	0	0	27.27	27.27	9.10
51-75	13.4	13.4	6.67	9.09	0	45.45
75-100	80	86.6	93.33	27.27	45.46	45.45
Max (%)	100	100	100	100	100	100
Min (%)	42.2	68.0	62.0	8.7	12.5	43.9
Mean (%)	87.6	93.4	93.0	45.3	60.3	74.3

Efficiency of wheat cultivation in Uttar Pradesh

The efficiency of wheat cultivation both under conventional and organic farming systems in Uttar Pradesh is summarized in table 7.17. The mean technical and scale efficiency values were higher (relatively) in conventional system when compared to organic system. There is ample scope for further increase in the efficiency of organic wheat farms in U.P. The conventional farms were relatively closer to their production frontiers than the distance between organic farms and their frontiers. Nearly 60 per cent of conventional farms were having the CRS-technical efficiency in the range of 75 to 100 per cent. But, only 30 per cent of organic farms showed this range of technical efficiency.

Table 7.17 Frequency distribution of technical and scale efficiencies of wheat farms

Efficiency %	Conventional farming (n= 14)			Organic farming (n= 16)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	18.8	0	0
26-50	7.10	0	0	12.5	6.25	31.25
51-75	28.6	14.3	7.1	37.5	12.5	31.25
75-100	64.3	85.7	92.9	31.2	81.25	37.5
Max (%)	100	100	100	100	100	100
Min (%)	45.5	58.8	54.4	12.6	32.2	27.9
Mean (%)	85.1	90.9	93.3	60.8	89.6	65.2

Efficiency of sugarcane cultivation in Maharashtra

The findings from the efficiency of sugarcane cultivation in Maharashtra are presented in table 7.18. The empirical findings show that the conventional farms were having higher (97.6 per cent) efficiency than the organic farms (77.6 per cent), relative to their production frontiers. The result would suggest that there exist ample margin for the increasing of managerial and technical skills as to improve performance in organic sugarcane-growing in order to compensate adequately the gap (with respect to conventional farms) in terms of efficiency. The technical efficiency of conventional farms ranged from 89.2 to 100 per cent where as the same in case of organic farms 45.1 to 100 per cent. Moreover, these findings were against to results obtained by Tzouvelekas *et al* (2001a) in Olive-farms in Greek.

Table 7.18 Frequency distribution of technical and scale efficiencies of sugarcane farms

Efficiency %	Conventional farming (n= 5)			Organic farming (n= 8)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	12.5	12.5	0
51-75	0	0	0	37.5	37.5	0
75-100	100	100	100	50.0	50.0	100
Max (%)	100	100	100	100	100	100
Min (%)	89.2	-	89.2	45.1	47.5	89.0
Mean (%)	97.6	100.0	97.6	77.6	79.4	96.9

Efficiency of cotton cultivation in Gujarat

The estimated farm-specific, input-oriented technical efficiency measures for both farming methods are presented in table 7.19. The average input-oriented technical efficiency score is 88.2% for organic farms and 76.9% for conventional farms under CRS model. Hence, conventional farms may be viewed, in general, as more technically efficient than conventional farms. However, it should be stressed that since organic and conventional cotton farming represents different production technologies, organic cotton farms face a different production frontier from the conventional ones. Therefore the differences between the average technical efficiency score of organic farms and that of conventional farms does not imply that conventional are more efficient than organic farms, by the same degree.

Table 7.19 Frequency distribution of technical and scale efficiencies of cotton farms

Efficiency %	Conventional farming (n= 4)			Organic farming (n= 14)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	7.2	0	7.2
51-75	25	0	25	42.8	0	42.8
75-100	75	100	75	50.0	100	50.0
Max (%)	100	100	100	100	100	100
Min (%)	67.7	-	67.7	50.0	-	50.0
Mean (%)	88.2	100	88.2	76.9	100	76.9

Overall across different states and crops, the efficiency levels were lower in organic farming when compared to conventional farming, relative to their production frontiers. There was only one exception in case of cotton in Punjab where the reverse trend was observed. The results conclude that there is ample scope for increasing the efficiency under organic farms. Exposure to more trainings as well as increase in technical guidance would enhance the efficiency of organic farms.

7.3 Factors influencing efficiency in organic crops

The factors influencing efficiency in the organic crops was analyzed by fitting a multiple regression equation. The efficiency of farm selected as dependent variable and it was regressed against different household characteristics. Ordinary Least Square (OLS) method was employed for estimating regression coefficients in the regression equation. Due to the limitations in the number of observations, regression equation was fitted only for wheat crop in Punjab and cotton crop in Gujarat. The summary of these results are presented in tables 7.20 and 7.21.

Two efficiency parameters (TE-CRS and SE) were used as a dependent variable in case of organic wheat crop in Punjab. The TE-VRS results were not presented because it was a very poor fit. Household head characteristics like education, number of family members participate in the farm, size of land holding (acres) and experience in growing organic wheat crop (years). A dummy variable (Y=1 or N=0) was used for participation or undertaken any formal training in organic farming. Another dummy was used for source of organic inputs like seeds and compost etc (if it is own =1 or bought from market=0).

The best fit among the two regression equations was technical efficiency under CRS model. Among different factors, education of the household is positive and significant at 5 per cent level. The participation in the formal training increased the efficiency of the farms. It is also significant 5 per cent level. None of the other variables were significant in the regression equation. The increase in number of family labor and input type both have showed a negative sign, but they are not statistically significant.

The adjusted R-square value for regression equation on scale efficiency was 0.478. Variables like education, size of land holding and participation in formal training programs showed a positive relation with scale efficiency. The contribution of family labor had a negative relationship with scale efficiency. It was statistically significant at 10 per cent level. The years of experience in growing organic wheat did not showed any impact on efficiency of farm.

Table 7.20 Determinants of efficiency in organic wheat (Punjab)

Variable	CRS- TE	SE
Constant	-0.668 (-1.622)	-0.642 (-1.742)
Education	0.543** (2.488)	0.451*** (1.947)
Family labor	-0.690 (-1.576)	-0.952*** (-2.050)
Landholding	0.828 (1.903)	1.039*** (2.247)
Experience	-0.250 (-1.155)	0.178 (0.775)
Training (dummy)	1.163** (3.245)	1.275** (3.352)
Input type (dummy)	-0.364 (-1.275)	-0.391 (-1.291)
R-square	0.768	0.739
Adjusted R-square	0.537	0.478
N	13	13

Figures in the parenthesis indicates‘t’ values
* Significant at 1 per cent level
** Significant at 5 per cent level
*** Significant at 10 per cent level

Table 7.21 Determinants of efficiency in organic cotton (Gujarat)

Variable	CRS- TE
Constant	0.414 (1.546)
Education	0.471 (1.799)
Family labor	-
Landholding	-
Experience	0.388 (1.482)
Training (dummy)	-
Input type (dummy)	-0.446*** (-1.854)
R-square	0.424
Adjusted R-square	0.251
N	14

Figures in the parenthesis indicates't' values
* Significant at 1 per cent level
** Significant at 5 per cent level
*** Significant at 10 per cent level

The determinants of efficiency of organic cotton crop in Gujarat are presented in table 7.18. The adjusted R-square value of the equation was 0.251. Since there was a correlation between number of family labor and size of land holding, both these variable were dropped from the equation. Similarly, the dummy on training was also excluded because all the growers had a formal training with Agrocel Industries Ltd. Only the dummy variable on 'input type' showed a negative relation with technical efficiency. It indicates that the farmers who are using their own inputs in the farms showed less efficiency when compared to the farmers who buy from outside market.

On the whole, the regression results conclude that the education and formal training programs have significant impact on efficiency of organic farms. The improvement of organic crop management skills should also be extended to all the family members working in the farms. More training and demonstration programs are needed for farmers to increase the quality of their own organic inputs production.

7.4 Suggestion for expansion of organic farming

Suggestions for strengthening of organic farming were elicited both from organic farmers as well as organic input producers' during the field visits. Some of the major responses are:

a. Creation of separate ‘Green channels’ for organic foods

The major problem of organic producers is absence of separate ‘Green market channels’ for organic foods. Most of farmers were selling their organic food in local conventional market. Lack of recognition and demand from consumers force the farmers for distress sales. Especially, the farmers who produce organic sugarcane in U.P and Maharashtra states have no option to sale the organic cane to sugar factories. Neither it is beneficial to society nor the farmers getting premium prices. The Public-Private-Partnership (PPP) model of marketing of organic products at least at the district level will boost marketing of organic sector in the country.

b. Premium prices should be announced for organic products

Another major problem for organic food is lack of premium prices in the market. Absence or assurance of attractive prices for organic food puts the organic growers in risky situation. Lower productivity coupled with lack of premium prices for organic products yields lower returns per acre than conventional farming. So, the government should announce premium prices for at least staple food crops like paddy, wheat, jowar, bajra etc.

c. Creation of demand through more awareness programs

Adoption of modern farming has resulted in land degradation and environmental pollution besides creating a very unsustainable system for mankind. Many long-term experiments conducted in the world have proved that the organic farming increases the crop productivity while sustaining the eco-system. Hence, the role of government is critical in motivating the farmers towards organic farming by more awareness programs and field demonstrations. These programs should also be aimed to influence the ultimate consumers about benefits of organic food.

d. Input put/conversion subsidies for organic farming

Conversion from inorganic to organic farming takes a while for the soil to adjust to both biological and chemical change processes. Many studies have concluded that the farmer may face initial year’s lower yields when compared to conventional farming. There is a time lag of 2-3 years for attaining competitive yields in organic farming. Therefore, to encourage organic farming in the country, government should provide input/conversion subsidies to organic growers who are facing these losses in the initial years.

e. More R& D investments and technical support to farmers

Many developed countries (Europe, USA, Germany etc) are investing huge amounts in organic agricultural research, extension and development activities. But, our country investments on organic research and development were very low. There is no specific extension and technical support division to address the organic farmers' problems. Thus, involvement of state agricultural universities and agricultural departments is necessary for rapid expansion of organic farming in the country.

f. Cheap and quick certification process

Organic certification and costs involved in this process is another major problem for growth of organic certified area in the country. Many of the organic farmers are belongs to small and marginal category. The complex and high costs of certification process is burden to them during conversion phase. Development of an innovative cheap and simple certification process would help in bringing more cultivated area under organic farming.

g. Availability of high quality certified organic inputs

Availability of quality organic inputs is crucial for success of any farming. Due to absence of quality organic inputs in markets, the illiterate poor organic farmers are using adulterated organic inputs. It is not only causing yield losses to farmers, but also leading to loss of faith on organic farming. So, the need of the hour is development of organic input marketing channels in the country. It will improve both the productivity and efficiency of organic farming in the country.

****

Chapter VIII

Summary and Conclusions

India had developed a vast and rich traditional agricultural knowledge since ancient times and presently finding solutions to problems created by over use of agrochemicals. Today's modern farming is not sustainable in consonance with economics, ecology, equity, energy and socio-cultural dimensions. Indiscriminate use of chemical fertilizers, weedicides and pesticides has resulted in various environmental and health hazards along with socio-economic problems. Chemical base farming system is no more beneficial as it requires high input and low return, resulting migration of youth from rural area to urban area in search of other jobs. Besides that cultivable area and forest land is shrinking day by day and become biggest threat to habitat of animals and birds. Though agricultural production has continued to increase, but productivity rate per unit area has started to decline.

The entire agricultural community is trying to find out an alternative sustainable farming system, which is ecologically sound, economically and socially acceptable. Sustainable agriculture is unifying concept, which considers ecological, environmental, philosophical, ethical and social impacts, balanced with cost effectiveness. The answer to the problem probably lies in returning to our own roots. Traditional agricultural practices, which are, based on natural and organic methods of farming offer several effective, feasible and cost effective solutions to most of the basic problems being faced in conventional farming system. There is also need to conserve our traditional seed, some of which have drought resistant properties and resistant to different pest and diseases. Many long term studies have reported that soil under organic farming conditions had lower bulk density, higher water holding capacity, higher microbial biomass carbon and nitrogen and higher soil respiration activities compared to the conventional farms. This indicates that sufficiently higher amounts of nutrients are made available to the crops due to enhanced microbial activity under organic farming.

Organic agriculture is developing rapidly; its share of agricultural land and farms continues to grow in many countries. According to the FiBL Survey, 2008; almost 30.4 million ha are managed organically by more than 7,00,000 farms (based on

2006 consolidated data). Oceania holds 42 per cent of the world's organic land, followed by Europe (24 per cent) and Latin America (16 per cent). On a global level, the organic land area increased by almost 1.8 million ha compared to the previous year, 2005. Global demand for organic products remains robust, with sales increasing by over five billion US dollar a year.

India is bestowed with lot of potential to produce all varieties of organic products due to its agro-climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. Currently, India ranks 33rd in terms of total land under organic cultivation and 88th position for agriculture land under organic crops to total farming area. The cultivated land under certification is around 2.8 million ha (2007-08, 1.9% of GCA). This includes one million ha under cultivation and the rest is under forest area (wild collection) (APEDA, 2010). India exported 86 items during 2007-08 with the total volume of 37533 MT. The export realization was around 100.4 million US $ registering a 30 per cent growth over the previous year (APEDA, 2010).

With having such a due importance of organic farming in India, the important event in the history of the modern nascent organic farming was the unveiling of the National Programme for Organic Production (NPOP) in 2000. The subsequent accreditation and certification program was started in 2001. The implementation of NPOP is ensured by the formulation of the National Accredited Policy and Program (NAPP). Later, the Department of Agriculture and Cooperation, Ministry of Agriculture has also launched a central sectoral scheme entitled "National Project on Organic Farming (NPOF)" during Xth five year plan. The main objective of the program are: capacity building through service providers; financial support to different production units engaged in production of bio-fertilizers, fruit and vegetable waste compost and vermi-hatchery compost; human resource development through training on certification and inspection, production technology etc. Development of model organic farms, market development, developing domestic standards and creating awareness were other components in the project. To implement the various schemes, Ministry has prepared detailed guidelines for each component.

Setting up of organic input units with capital investment subsidy is one of major component under NPOF for encouraging the organic inputs production since 2004. Availability of quality organic inputs is critical for success of organic farming in India. To promote organic farming in the country and to increase the agricultural productivity while maintaining the soil health and environmental safety; organic input units are being financed as credit-linked and back-ended subsidy through NABARD and NCDC. These units will not only reduce the dependency on chemical fertilizers but also efficiently convert the organic waste in to plant nutrient resources. Three types of organic input production units namely; Fruit/vegetable waste units, Bio-fertilizer unit and Vermi-hatchery units are being supported @ 25 per cent of their total project costs respectively. Around 455 vermi-hatchery units, 31 bio-fertilizer units and 10 fruit and vegetable waste units were sanctioned across different states by NABARD till May, 2009. But, NCDC has so far sanctioned only two bio-fertilizer units in Maharashtra state.

At this juncture, it is very interesting to know what the present status of these units, what the production and capacity utilization of each unit and suggestions for enhancing capacity utilization etc. It is also very important to get the feed back from promoters for further improving in the implementation of the scheme. However, very little effort has been made so far to find out the performance of organic input units in terms of its capacity utilization, cost of production and efficiency. Very few attempts were also made till now to assess the economics and efficiency of organic farming in India. Such analysis can provide valuable insights for undertaking appropriate measures for faster expansion organic farming in the country. With this background, broadly the present study has been planned to cover the following major issues:

1. To perform SWOT analysis of organic farming to articulate and refine policy prospective and schemes
2. What is the present status of organic input production in India?
3. To evaluate the capacity utilization and efficiency of production units sanctioned under NABARD and NCDC
4. What are the constraints in establishment of units and identification of problems in marketing of organic inputs?
5. To examine constraints in procuring and using organic inputs by the farmers

6. What is economics and efficiency of organic farming in India?
7. What are the suggestions for effective implementation of project?

The study addresses the wide range of problems of conventional/modern farming with the foundation of various research studies. It also covers the status of organic farming in the World and India. This study presents a model based non-parametric DEA approach for efficiency analysis of organic input units. Multiple regression models are also used to estimate the drivers for efficiency in input units. The same DEA approach is also used for estimating the efficiency between organic and conventional farming systems. Similarly, the determinants for efficiency in organic farming are also estimated.

8.1 Major findings and conclusions

A scan of the internal and external environment is an important part of the strategic planning process. Organic farming has several major strengths than conventional farming. The major strengths are: organic farming provides safety, healthy and tasty organic food which 'lives up to its promise'; high comparative advantage in organic food production such as tea, spices, coffee, rice, wheat, cotton and vegetables etc; low cost of production; high quality and improved nutrition of organic food; improves the soil health; fetch premium prices for organic food; environmental sustainability; high water-use-efficiency; favorable government initiatives like NPOP and NPOF for promotion organic farming in the country; it preserves traditional varieties and bio-diversity and increases self life of food etc. With all these strengths, India can significantly play a major role in the international organic market.

Despite of many benefits in organic farming; why many farmers are not adopting it? Organic farming has limited weaknesses when compared with conventional farming. They are: initial productivity gaps in cultivation; it is intensive and needs high labor; lack of established output markets; poor quality management in production and processing; less incentives from government; limited research and development investments on organic farming research; most of the organic markets are buyers/consumer driven rather than supply/producer driven; lack of clear strategy for development of organic faming in the country; disjointed producers, processors and traders; availability of poor or adulterated quality organic inputs; large number of small farms with weak organizational building etc. Until and unless we remove these weaknesses in the system, the growth of organic farming is questionable!

The Indian organic farming has several opportunities to reap the untapped benefits in the future. They include: big and growing organic domestic market potential; growing purchasing power of consumers; nearly 70 per cent of gross cropped area under rain fed with limited fertilizer application; growing health awareness of consumers; can reduce heavy subsidies on food and fertilizers; control the nitrate leaching and CO_2 emissions and finally earn substantial export earnings. If India could tap all these potentials avenues, the growth in agriculture shall easily surpass the mile stone of 4 per cent per annum.

There are few possible threats for expansion of organic farming in India. The major concerns are: high cost of organic food relative to conventional food; costly and complex nature of organic certification process; lack of sufficient number of infrastructure facilities and certification bodies; only export regulated organic market; low awareness about usage of organic inputs; most of the Indian fields are contiguous and problem of contamination and lastly interest towards introduction of GM crops in to the country.

Recently, Government of India has taken policy initiatives like NPOP and NPOF for promotion of organic farming in India. The review of various policies indicates that some of the nagging policy issues will hinder the growth of organic farming in the country. In India, APEDA is the highest controlling body for organic certification for export. Till date there are no domestic standards for organic produce within India. Although there is no system for monitoring the labeling of organic produce sold within India, which particularly affects the retail market. Many researchers have noted that the rapid increase in organic sales and certified acreage around the world is not matched by an equal rate of growth in the number of organic farms as might be expected. In an attempt to reduce the inequality of this trend, a number of alternative methods to guarantee the organic integrity of products have to be developed for small domestic producers (like PGS). An innovative cost effective certification method uniform in standards across various countries need be developed to connect numerous small and marginal farmers in the country.

India has enough potential for production of sufficient quantities of organic inputs. Substantial capacities have been generated for production of different organic manures through diverse state and central financial assistance schemes. As per NCOF (2007-08), the total compost/vermi-compost production (includes rural, urban, FYM and other sources) at all India was 3830.9 lakh tones and area covered by these units was 1694.8 lakh ha. Similarly, the total green manure production in the country was 133.5 lakh tones with 13.0 lakh ha area coverage. The total installed capacity created for production of different bio-fertilizers in the country was 67162 tons. But, their actual production of different bio-fertilizers was 38932.6 tons. This data clearly indicates that only 58 per cent of their capacity was utilized. However, the growth in production of bio-fertilizers was quite significant when compared to 2004-05. The results also showed that the total production of bio-fertilizers was the highest in case of Tamil Nadu followed by Karanataka, Andhra Pradesh and Kerala. It also concludes that the awareness and usage of bio-fertilizers was higher in south zone than other zones in India. Among different types of bio-fertilizers, the share of Phosphorous Solubilizing Bacteria (PSB) production was higher. The status of bio-pesticides production in India is still in infant stage. The production is slowly gaining momentum with the increased awareness of the farmers.

To assess the capacity utilization and efficiency of organic input units, a random sample of 40 vermi-hatchery units were identified purposively from four states of India. They are namely; Gujarat, Maharashtra, Punjab and U.P states. Similarly, two fruit and vegetable waste units and four bio-fertilizer (3 NABARD + 1 NCDC) units were also chosen for present study. The detailed cases on fruit and vegetable units and bio-fertilizer units are presented in chapter 5.

The primary data was collected from 40 vermi-harchery units through a structured questionnaire and the data was analyzed. The empirical results were summarized and elaborately discussed in the Chapter 4. Overall, only three beneficiaries (7.5%) out of 40 were having vermi-hatchery as their primary occupation. Most of the sample beneficiaries expressed agriculture as major source of income. Correspondingly, only 7.5 per cent sample dependent on vermi-hatchery as their secondary source of income. These results suggest that most of the beneficiaries are not taking up the vermi-hatchery units in a commercial way.

Around 97.5 per cent of the sample promoters are educated. The average size of family was 6.3. The average no.of family members participating in the vermi-hatchery units were 1.5. Out of 40 units, only 22 units were functioning on the day of visit. The main reasons for not functioning are: lack of demand for vermi-compost, neither JMC visit nor subsidy release from NABARD, death of worms in high temps, heavy rains and floods. The number of non-functioning units were maximum (100%) in case Gujarat. NABARD has finished the conduct of JMC visits only in case of 70 per cent units. The remaining 30 per cent units are still waiting for JMC visits and final subsidy. This indicates a huge delay in the process of subsidy release. Out of the 28 units (70%) who completed JMC visits, only 19 units have received the final subsidy amounts. Almost 32 per cent of units are waiting for release of final subsidy. This was another bottleneck in the scheme where lot of time was consuming for processing. A lone farmer in the entire sample was succeeded in obtaining the license/certification for his product. Most of the promoters did not have any awareness about these aspects.

On an average, the total financial out lay per unit was Rs.5.9 lakh. The outlay was the highest in case of Maharashtra whereas it was the lowest in Punjab. The results conclude that there is a huge gap between subsidy released till now (0.93 lakh) and eligible subsidy (1.5 lakh) per unit. This gap is the highest in case of Gujarat (1.23 lakh) followed by U.P (0.27 lakh) and Punjab (0.25 lakh). Some of the main reasons for this difference are: non-adoption of NABARD guidelines while establishing the units and lot of delay in release of final subsidy after JMC team visited the unit. Nearly, 78 per cent of the units were financed by commercial banks and the remaining by cooperative banks.

Capacity utilization is a concept refers to the extent to which an enterprise actually uses its installed productive capacity. The average installed capacity of the sample units was 150 TPA. But, the mean production was around 76.2 TPA. The average capacity utilization rate was only 50.8 per cent which indicates nearly half of its fulI potential. Across different states, this value was the highest in Maharashtra (124.6%) followed by U.P (70.0%), Punjab (22.0%) and Gujarat (16.1%). The main reasons for low capacity utilization were lack of demand, poor production skills and insufficient infrastructure. Based on promoters’ past experiences in vermi-compost, the data on different productivity indicators were also collected. In general, the average working days per annum were 332 days. The average recovery rate for entire sample was 42.7 per cent. The highest recovery rate was noticed in case of Maharashtra (52.5%) followed by Gujarat (48.0), U.P (39.7%) and Punjab (33.3%). The average gestation period per cycle for the entire sample was 48.8 days. The capacity utilization under fruit and vegetable waste units and bio-fertilizer units showed a mix trends.

The state-wise detailed break-up of average cost of production, yield, and gross returns of sample vermi-hatchery units were calculated. The cost of production of vermi-compost per quintal in Gujarat was Rs.453. But, the same was Rs.218 per quintal in case of Maharashtra state. The huge differences between these two Western states were due to low productivity and capacity utilization in Gujarat. Similarly, the costs of production per quintal in Punjab and U.P were Rs.433 and Rs.324 respectively. Over all, the weighted average cost of production per quintal was Rs.286. The price realization and net margins were Rs.506 and Rs.220 per quintal respectively. The results indicates significant margin for promoters in this venture. Among different cost components, the lion share was occupied by raw materials followed by labor costs and seed stock. Between two regions, the cost of production was slightly higher (42.8%) in Northern region when compared to Western region. But, the price realization (49.4%) and net margin (58.4%) per quintal of compost were higher for Northern region indicating higher demand in that region.

The estimated mean technical, allocative and economic efficiencies of sample vermi-hatchery units under DEA-CRS model were 63.7, 50.95 and 32.95 per cent respectively. The results clearly indicate the low technical, allocative and economic efficiency of sample units. Correspondingly, the mean values for DEA-VRS model were 83.39, 59.42 and 50.24 per cent. The frequency distribution of technical efficiency of sample units indicated that about 45 % of the sample units have more than 90 per cent efficiency (under VRS) where as only 20 % of the sample units were belonged to that category under CRS assumptions. In case of allocative efficiency, 40.0 and 47.5 per cent samples fell under less 50 per cent category respectively under VRS and CRS models. This concludes that majority of the sample units are inefficient in allocating their inputs. The percentile distributions of sample units fell below 50 per cent economic efficiency were 85.0 and 57.5 respectively under CRS and VRS assumptions. It signifies that the organic inputs are suffering from both technical inefficiency as well as allocative inefficiency. The mean scale-efficiency of the sample was 77.7 per cent. Among different states, the mean technical efficiency under CRS model was the highest for Maharashtra (0.84) followed by U.P (0.69), Gujarat (0.55) and Punjab (0.52). However when compared between regions, slightly higher efficiency was observed in Northern region.

The socio-economic characters of promoters were regressed against efficiency values to determine the drivers for efficiency in vermi-hatchery units. The results concluded that the size of the unit, contribution of family labor have shown positive relation with technical as well as scale-efficiencies. Participation in the training programs is also enhancing technical efficiency. The age of the unit and subsidies discouraged the scale-efficiency.

Out of the total sample, only six promoters have repaid entire borrowed loan amount from bank. Nearly 85 per cent of the sample promoters are having unpaid loans with bank. Almost, half of the sample promoters were categorized as regular payers by the bank authorities. Overall, 67.5 per cent beneficiaries obtained preliminary training in vermi-compost production. Majority of U.P promoters have undergone training since NCOF is situated in the same state.

Majority of the sample promoters did not face any problem in establishment of vermi-hatchery units. Very few expressed some difficulties while establishing them. The major problems are: non-availability of quality worms in the vicinity, lack of sufficient raw materials, wild boar attacks on compost units, no proper guidance from NABARD, heavy rains and delay in release of bank loan amounts etc.

Almost all vermi-hatchery units are following direct sales method rather than depending upon any other intermediary. The quantity of total sales is very high in direct sales. Nearly half of the sample promoters expressed that they are facing severe marketing problems in marketing of their compost. The main reasons are lack of demand, sales on credit basis, very low unit prices and absence of proper input marketing channels. Lack of certification/licensing facilities are also discouraging promoters to export their compost. Adulteration of organic inputs also exacerbates the situation.

To elicit the information about the problems in procurement and usage of organic inputs, about 15 organic farmers per state (a total of 60) were interviewed during field visits. The sample organic farmers did not express any specific problems in procurement of seeds. The problems in procurement of compost are lack of organized marketing channels, absence of product standards and certifications. Similarly, lack of distribution networks at block level, product standardization and lack of supervision on adulterated products are the difficulties in case of bio-fertilizer procurement. Farmers are looking for more awareness/training programs in case of usage of bio-fertilizers. Most of sample farmers are quite satisfied with usage of botanical pesticides for controlling the pests and diseases. But, the awareness and usage of bio-pesticides like Trichoderma, Pseudomonas, Verticillium etc are limited among sample farmers.

Due to very little accessible information on economics and efficiency of organic farming in India, an attempt is made to assess it in different crops and states. The results showed mixed response. In general, organic farming is a production system which has low productivity levels, needs more labor, require low energy inputs and has a changing net income levels along with selling prices. Overall, crop economics results concluded that the unit cost of production is lower in organic farming in case of cotton (both in Gujarat and Punjab) and Sugarcane (both in U.P and Maharashtra) crops where as the same is lower in conventional farming for Paddy and Wheat (both in Punjab and U.P) crops. The mixed results are in conformity with the findings of Lampkin and Padel, 1994. The DEA efficiency analysis conducted on different crops indicated that the efficiency levels are lower in organic farming when compared to conventional farming, relative to their production frontiers. These results conclude that there is ample scope for increasing the efficiency under organic farms. The determinants of the efficiency in organic farming are education of the farmer and formal participation in training programs.

The broad suggestions for promotion of organic input units are collected from the respondents. The major issues are: prompt and timely conduct of JMC visits; quick and timely disbursement of subsidies to promoters; inclusion of buffaloes, training on vermi-compost production and insurance components in the going scheme; help in easy licensing and certification of compost; supply of quality seed stock at cheaper rates; intervention of NABARD/state Govt./ SAUs in marketing of compost; encouragement of organic inputs usage by subsidies; creation of market demand by promoting more awareness programs and finally further increase in subsidy upper limit in the establishment of input units.

8.2 Policy implications

The Ministry of Agriculture should introduce favorable governmental policies and strategies for the promotion of organic farming in India. These should include:

- A single authority at national level with a well-defined role should be responsible for the organic sector. An important role would be the responsibility for regulating and supervising the organic sector at domestic level, including any foreign bodies active in the country. With regard to export, the national authority should act as counterpart to the authorities of the importing countries and could thus strengthen the organic sector's export potential.
- The national authority should link with other institutes, NGOs, farmers' organizations and the private sector in designing strategies to support and energize the organic sector, particularly in the fields of research, training, extension, post-harvest handling and marketing. Through linking with the different sectors, substantial experiences can be brought together and organized in a strategic and coordinated way.
- Current market demand is considerably higher than the supply, a situation which creates potential opportunities for countries in the short and medium term. So, India should use this opportunity timely to tap the national and international markets by framing a well defined strategy on organic farming sector at the national level. The development of international markets can also stimulate domestic as well as regional market opportunities.
- The quality organic input production (compost, bio-fertilizers and bio-pesticides) in the country should be further encouraged with latest

technologies and improved way of financial assistance so as to reduce the high dependency on inorganic-fertilizers in a phase manner and to save our domestic subsidies. It not only protects our soil health but also sustains the environmental and natural resources.

- The organic input units established under various schemes in the country should be linked up with suitable market channels to improve their capacity utilization or to make use of entire installed capacities. NABARD /state Agil dept/ IFFCO should intervene in providing necessary support for their marketing of organic inputs. Establishment of organic input marketing channels is the need of the hour for expansion of organic farming in the country.
- The technical efficiency of organic input production should also be enhanced by imparting more production skills to the promoters. The economic and scale efficiency of the units should also be improved by providing more technical guidance, quality seed stock and training programs.
- Government should take a lead role in conduct of training and demonstration programs for creating more awareness about use of different organic inputs and their benefits. The state agricultural department and state agricultural universities should also actively involve in these programs and should also promote through their extension services. So that it will not only boost the confidence of the farmers and but also increases the demand for organic inputs. The demand should also be enhanced by subsidizing the usage of organic inputs in the country.
- Creation of 'Green markets' or output market channels/linkages should be developed for marketing of organic produce in the country. The promotion of the organic sector in the country must involve development of complete product chains including some value addition and export strategies.
- Support structures should be introduced for small farmers' group certification. Local competencies for inspection and certification are increasing, which leads to a strengthening of the local organic sector. Methodologies for group certification are functioning technically, but need political recognition. Competencies for inspection and certification are increasing in the country

and providing opportunities to ‘localize’ the organic sector. This trend needs more political strengthening vis –à-vis international trade.

- A comprehensive program/scheme should be developed to assist the farmers that who want to convert their lands from conventional to organic farming. It includes some conversion or input subsidies, providing technical guidance and finally certification of farm. It will dramatically expand the organic farming in the country and ultimately sustains our food production.
- Increase investments are needed on research and development activities in organic agriculture and to scale-up the projects that have already proven successful. The efficiency of organic farming should be improved by disseminating improved methods of cultivation and packages of practices. The Indian Council of Agricultural Research (ICAR) should take an initiative in developing common course curricula on organic farming across different universities in the country.
- The establishment of a monthly information bulletin for farmers on local and international prices for organic food items as well as inputs should be developed. Similarly, establishment of systematic data/information about various levels of organic product chains and market opportunities at internationally, regionally and domestically are needs to be developed. Regional information exchange on organic farming methods and research results should be encouraged from international players like FAO, ESCAP, the International Trade Centre and IFOAM etc to country level players and finally to local farmers.
- Finally, the most important task would be to ensure consistency of government policies on organic sector. Through focusing of policies and activities, the organic sector can be developed more quickly and more effectively. Institutional barriers to the development of the organic sector are considered greater than the technical and trade barriers. So, most relevant institutions and partners should be prepared to competently involve in the promotion of the organic sector in the country.

****

Bibliography

Acharya S.S and N.L Agarwal (2008) Agricultural Marketing in India, *Oxford and IBH Publications*, *New Delhi*

A Survey of Sustainable Development – Social and Economic Dimensions (2001) (Eds.) Jonathan M.H, Timothy A.W, Kevin P.G and Neva R.G, *ISLAND Press*, *Washington D.C*

Admassie A. and Matambalya F.A.S.T (2002) Technical efficiency of Small and Medium scale Enterprises: Evidence from a survey of enterprises in Tanzania, *Eastern Africa Social Science Research Review*, *Vol no.18 (2), Pp: 1-29*

Adewumi M.O and Adebayo F.A (2008) Profitability and Technical Efficiency of Sweet Potato Production in Nigeria, *Journal of Rural Development*, *31 (5), Pp: 105-120*

Aggrey N., Luvanda Eliab and Shitundu Joseph (2010) Firm size and Technical efficiency in East African manufacturing firms, *Current Research Journal of Economic Theory*, *Vol 2(2), Pp: 69-75*

Alexander (1973) Environmental Consequences of increasing food production, *Biological Conservation*, *Vol.5 no.1 January*, *Applied Science Publishers Ltd, England*

Ali, A.I. and Seiford, L. (1993) The Mathematical Programming Approach to Efficiency Analysis, in (Eds.) H.O Fried, C.A.K Lovell and S.S Schmidt, The Measurement of Productive Efficiency, Pp: 129-159, *Oxford University Press, New York*

AME (1999) “Farm system comparison; country case study report”, *draft, June 1997-May 1999, Bangalore*

Anderson M.D (1994) Economics of organic farming in USA, The economics of organic farming – An international perspective, Edited by Lampkin N.H and Padel S., *CAB International Publishers*

APEDA (2010) www.apeda.com accessed on 20th January, 2010

Athreya V B., Gustav Boklin, Goran Djurfeldt and Staffan Lindberg (1986) Economies of Scale or Advantage of class? Some results from a South Indian Farm Economy Study, *Economic and Political Weekly*, *Vol XXI, No.13, Mar 29, Pp:A2-A14.*

Ayinde O. E; Adewumi, M.O and Ojehomon, V.E.T (2009) Determinants of technical efficiency and varietal-gap of rice production in Nigeria: A meta-frontier model approach, Paper prepared and presented at the *International Association of Agricultural Economists Conference*, *Beijing, China, August 16-22, 2009*

Badgley, Catherine; Jeremy Moghtader; Eileen Quintero; Emily Zakem; M. Jahi Chappell; Katia Aviles-Vazques; Andrea Samulon; and Ivette Perfecto. (2007) Organic Agriculture and the Global Food Supply. *Renewable Agriculture and Food Systems, 22:86-108 Cambridge University Press*

Balk, B.M (2001) "Scale Efficiency and Productivity Change", *Journal of Productivity Analysis", 15, 159-183*

Banker, R.D., Charnes, A and Cooper, W.W (1984) Some models for estimating technical and scale inefficiencies in Data Envelopment Analysis, *Management Science, 30, Pp: 1078-1092*

Barbier, E., (1987) The Concept of Sustainable Economic Development, *Environmental Conservation, 14(2):101-110*

Battese G.E and Tessema G.A (1993) Estimation of Stochastic Frontier Production Functions with time-varying parameters and technical efficiencies using panel data from Indian Villages, *Agricultural Economics, 9, Pp: 313-333*

Battese, G.E (1992) "Frontier Production Functions and technical efficiency: A survey of empirical applications in Agricultural Economics, *Agricultural Economics, 7, Pp: 185-208*

Bauer, P.W (1990) Recent Developments in the Econometric Estimation of Frontiers, *Journal of Econometrics, 46, Pp: 39-56*

Bayramoglu Z. and E. Gundogmus (2008) Cost efficiency on organic farming: a comparison between organic and conventional raisin-producing households in Turkey, *Spanish Journal of Agricultural Research 2008 6(1), 3-11*

Begum I.A, Buysse J, Alam M J and Huylenbroeck G.V (2009) An application of Data Envelopment Analysis (DEA) to evaluate economic efficiency of poultry farms in Bangladesh, Contributed paper prepared and presented at *International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009*

Bellamy, P.H.; Loveland, P.J.; Bradley, R.I.; Lark, R.M. & Kirk, G.J.D. (2005) Carbon losses from all soils across England and Wales 1978–2003, *Nature, 437, 245-248*

Bellarby, J., Foereid, B., Hastings, A., Smith, P. (2008) "Cool Farming: Climate impacts of agriculture and mitigation potential", *Greenpeace International, Amsterdam (NL). 44 p*

Bhandari A.K and Subhash C.R (2007) Technical Efficiency in the Indian Textile Industry: A Non-parametric analysis of firm-level data, *Working papers 2007-49, Department of Economics, University of Connecticut, USA*

Bhargava S (1992) Management of Channel in Agricultural Input Industry in Agricultural Input Marketing – *CMA Monograph no.155, (eds.) Setharaman, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi*

Bhattacharya P and Chakraborty G (2005) Current status of organic farming in India and other countries, *Indian Journal of fertilizers, Vol.1 (9), December 2005, Pp: 111-123*

Bhattacharya (2006) Organic agriculture (www.danet.nic.in/ncof/ accessed on 20-2-2010).

Biing-Hwan Lin, Travis A. Smith, and Chung L. Huang (2008) "Organic Premiums of U.S. Fresh Produce," in *Renewable Agriculture and Food Systems*, *23(3): 208-216, 2008.*

Bokusheva R and Hockmann H (2005) Production risk and Technical inefficiency in Russian Agriculture, Paper prepared for presentation at the XIth Congress of the *European Association of Agricultural Economists (EAAE), August 24-27, 2005*

Bravo-Ureta, B.E and Pinheiro, A.E (1993) Efficiency Analysis of Developing Country Agriculture: A Review of the Frontier Function Literature, *Agriculture and Resource Economics Review, 22, Pp: 88-101*

Campden Research Station (2008) Nutritional Status of fruits and vegetable crops, *A Review R61, ISBN 9780907503491*

Chauhan K.K.S (1992) Management of Agricultural Input Delivery Systems *In* Agricultural Input Marketing – *CMA Monograph no.155, (eds.) Setharaman, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi*

Cechura L. (2010) Estimation of technical efficiency in Czech Agriculture with respect to firm heterogeneity, *Journal of Agricultural Economics, Czech, Vol.56 (4) Pp: 183-191*

Cembalo, L., and Cicia, G (2002) Disponibilita di dati ed opporunita di analisi del database RICA biologico. In Scardera, A., Zanoli, R.(eds) L'agricoltura biologica in Italia. *Rome: INEA, 63-76.*

Centre for Science and Environment (1993) Green Farming: A directory of individuals and organizations, involved in sustainable agriculture in India, New Delhi

Charnes, A., Cooper, W. and Rhodes, E. (1978) Measuring the efficiency of Decision-making Units, *European Journal of Operations Research, 2, Pp: 429-444.*

Charnes, A., W.W Cooper, A.Y Lewin, R.C Morey, and J.Rousseau (1985c) “Sensitivity and stability analysis in DEA, *Annals of Operation Research, 2, Pp:139-156*

Charnes, A., W.W. Cooper, A.Y Lewin and L.M Seiford (1995) “Data Envelopment Analysis: Theory, Methodology and Applications, *Kluwer Publications.*

Coelli T and Battese G (1996) Identification of factors which influences the technical inefficiency of Indian farmers, *Australian Journal of Agricultural Economics, Vol no.40, No.2 (Aug), Pp: 103-128*

Coelli T.J and S.Perelman (1996) A comparison of parametric and Non-parametric Distance functions: with applications to European Railways, *CREPP Discussion Paper, University of Liege, Liege.*

Coelli T.J, D.S Prasada Rao, Christopher J.O’ Donnell and G. E Battese (2005) An Introduction to Efficiency and Productivity Analysis, *Second Edition, Springer Publication, USA.*

Coelli, T and Perelman, S. (1999) A Comparison of Parametric and Non-parametric distance functions: With application to European Railways, *European Journal of Operations Research, 117, Pp: 326-339*

Coelli, T. (1996) A Guide to FRONTIER Version 4.1: A Computer program for Stochastic Frontier Production and Cost Function Estimation, Centre for Efficiency and Productivity Analysis, *University of New England, Armidale, Australia.*

Coelli, T., (1995) “Recent Developments in Frontier Modelling and Efficiency Measurement, *Australian Journal of Agricultural Economics, 39, Pp: 219-245*

Coelli, T., Rao, P.D.S and Battese, G.E (2002) An Introduction to Efficiency and Productivity Analysis, *Kluwer Publishers, London*

Coelli, T., Sandura, R. and Colin, T. (2002) Technical, Allocative, Cost and Scale in Bangladesh Rice Production: A Non-Parametric Approach, *Agricultural Economics, 53, Pp: 607-626*

Coelli, T.J., (1996) A Guide to DEAP 2.1: A Data Envelopment Analysis Computer Program, CEPA working paper No.8/96, ISBN 1863894969, *Department of Econometrics, University of New England, Pp: 1-49*

Crucefix D. (1998) Organic Agriculture and sustainable rural livelihoods in Developing countries, *Department for International Developmental Natural Resources, Advisors Conference, UK.*

Dubgaard A (1994) Economics of organic farming in Denmark, The economics of organic farming – An international perspective, Edited by Lampkin N.H and Padel S., *CAB International Publishers*

Dwivedi Vandana (2005). Organic farming: Policy initiatives, Paper presented at the National Seminar on National Policy on Promoting Organic Farming, *10-11 March, 2005. pp.58-61.*

Economic Survey 2009-10, Planning Commission of India, *Government of India, New Delhi*

Emvalomatis G., Lansink A O and Stefanou S E (2008) An examination of the relationship between subsidies on production and technical efficiency in Agriculture : The case of Cotton producers in Greece, Paper prepared and presented at the 107th *EAAE seminar on "Modelling of Agricultural and Rural Development Policies", Sevilla, Spain, January 29th-Feb 3rd, 2008*

Erisman, J.W., Sutton, M.A., Galloway, J., Klimont, Z., Winiwarter, W. (2008): How a century of ammonia synthesis changed the world. *Nature Geoscience* 1, 636-639.

Eyhorn F., Mader P. and Ramakrishnan M., (2005) The Impact of Organic Cotton Farming on the Livelihoods of Smallholders. *FIBL Research Report, October 2005.*

Fabio A Madau (2007) Technical efficiency in organic farming and conventional farming: Evidence from Italian Cereal farms, *Agricultural Economics Review, Vol no.8, No.1*

FAO (2007) Assessment of the World Food Security Situation, *CFS:2007/2. Rome.*

Fare, R and D. Primont (1995) "Multi-output production and Duality: Theory and Applications, *Kluwer Academic Publishers, Boston.*

Fare, R., S. Grosskopf and P.Roos (1998), "Malmquist Productivity Indexes: A survey of Theory and Practice", in R.Fare, S. Grosskopf and R.R Russell (Eds.) Index Numbers: Essays in Honour of Sten Malmquit, *Kluwer Academic Publishers, Boston.*

Fare, R., S. Grosskopf, M.Norris and Z.Zhang (1994), "Productivity growth, Technical Progress, and Efficiency Changes in Industrialized Countries", *American Economic Review, 84, 66-83*

Fare, R.,S.Grosskopf and C.A.K Lovell (1994) Production Frontiers, *Cambridge University Press.*

Farrell, M.J (1957) Generalized Farrell Measures of Efficiency: An application to Milk processing in Swedish Dairy plants. *"Economic Journal", Vol no.89, Pp: 294-315*

FiBL survey (2008) The World of Organic Agriculture – Statistics and Emerging Trends, 2008, *Published by IFOAM*

Fließbach, A., and Mäder, P. (2000): Microbial biomass and size-density factions differ between soils of organic and conventional agricultural systems. *Soil Biology & Biochemistry 32, 757-768.*

Fließbach, A.; Oberholzer, H.R.; Gunst, L. & Mäder, P. (2007) Soil organic matter and biological soil quality indicators after 21 years of organic and conventional farming. Agriculture, *Ecosystems & Environment 118, 273-284.*

Fock K., (2001) "Development marketplace project: empowerment of rural communities to export organic spices", No. 886, second interim progress report, 13 March 2001, *UNCTAD/ WTO International Trade Centre*

Fried, H.O., Lovell C.A.K and Schmidt, S.S (Eds) (1993) The Measurement of Productive Efficiency: Techniques and Applications, *Oxford University Press, New York.*

Funtanilla M., Lyford C. and Wang C. (2009) An evaluation of organic cotton marketing opportunity, Paper prepared and presented at the Agricultural & Applied Economics Association.s 2009 *AAEA & ACCI Joint Annual Meeting, Milwaukee, WI, July 26-28, 2009.*

Ghosh N (2004) "Promoting Bio-fertilizers in Indian Agriculture" *Economic and Political Weekly, December 25, Pp: 5617-5625.*

Ghosh N. (2004) "Reducing dependence on chemical fertilizers and its financial implications for farmers in India", *Ecological Economics, Vol no.49, Pp: 149-162*

Ghosh N (2006) "Theory and Practice of Agricultural Indicators" review article in *Economic and Political Weekly, Vol XLI No.34, August 26, 2006.*

GM foods: Bane or Boon, *Science, April 13, 2009*

GOI (2001). The report of the working group on organic and biodynamic farming, Planning Commission*, Government of India. pp:1-25*

Good D.H, Nadiri M.I, Roller L.H and Sickles R.C (1993) Efficiency and Productivity Growth comparisons of European and U.S Air Carriers: A First look at the Data, *The Journal of Productivity Analysis, 4, Pp: 115-125*

Government of India, (2001) National Programme for Organic Production: *Accreditation Regulations (New Delhi)*

Government of India, (2001) National Programme for Organic Production: *Procedures for Accreditation (New Delhi)*

Government of India, (2001) National Programme for Organic Production*: Formats and Application Forms (New Delhi)*

Government of India, (2001) National Programme for Organic Production: *Accreditation Criteria for Inspection & Certification Agencies (New Delhi)*

Government of India, Ministry of Commerce and Industry, (2000) "National Programme for Organic Production" containing the standards for organic products, *New Delhi.*

Graner M. and Isaksson A. (2009) Firm efficiency and the Destination of Exports: Evidence from Kenyan plant-level data, *Journal of The Developing Economies, Vol no.47 (3), Pp: 279-306*

Grifell-Tatje, E and C.A.K Lovell (1999) "A Generalized Malmquit Productivity Index", *Economic Letters, 47, 169-175*

Haas G, Geier U, Frieben B and Kopke U (2005) Estimation of environmental impact of conversion to organic agriculture in Hamburg using the Life-Cycle-Assessment method, *Organic Agro-expertise Consultancy (www.agroexpertise.de), Germany*

Heshmati, A and Kumbhakar, S.C (1994) Farm Heterogeneity and Technical Efficiency: Some Results from Swedish Dairy Farms, *The Journal of Productivity Analysis, 5, Pp: 45-61*

ICMR Bulletin (2001) Pesticide Pollution: Trends and Perspective, *Vol.31, No.9, September, 2001, New Delhi.*

IFA, 2009: http://www.fertilizer.org/

IFOAM (2008) Criticisms and Frequent misconceptions about Organic Agriculture: The counter Arguments*, IFOAM publication.*

ILEIA/ETC-India, (1994) ILEIA/LEISA Network in India: *A Register of Indian Organizations*

Indebtedness of Farm household Survey in India, *NSSO 59th Round, 2003*

Indian Council of Agricultural Research (ICAR) (1997) *Handbook of Agriculture, (New Delhi)*

Indian Spice Board (ISB), (2001) "Organic spices -Indian capability", *www.indianspices.com/ html/s0650org.htm*

Iráizoz, B., Rapun, M., Zabaleta, I. (2003) Assessing the technical efficiency of horticultural production in Navarra, Spain, *Agricultural Systems, 78, Pp: 387-403*

JN Pretty, C Brett, D Gee, RE Hine, CF Mason, JIL Morison, H Raven, MD Rayment, G Van der Bijl, An assessment of the total external costs of UK agriculture, *Agricultural Systems,* 65 (2), 113-136, 2000.

Johansson, H., (2005) "Technical, Allocative and Economic Efficiency in Swedish Dairy Farms: The Data Envelopment Analysis Versus The Stochastic Frontier Approach", Poster paper presented at the XIth International Congress of the *European Association of Agricultural Economists (EAAE), Copenhagen, Denmark, 2005*

John Henning (1994) Economics of organic farming in Canada, The economics of organic farming – An international perspective, Edited by Lampkin N.H and Padel S., *CAB International Publishers*

Jonasson, L., (1996) "Mathematical Programming for Sector Analysis- Some applications, Evaluations and Methodological Proposals", Dissertation, *Swedish University of Agricultural Sciences, Department of Economics*

Jun-Yen L. (2005) Comparing SFA and DEA methods on measuring production efficiency for forest and paper companies, *Forest Products Journal, July issue*

Jules Pretty (2005) The Real cost of Modern farming, available at *http://www.resurgence.org/resurgence/issues/pretty205.htm*

Kaiser, J. (2004) Wounding earth's fragile skin, *Science, 304, p 1616-1618*

Kallander I (2007) Participatory Guarantee System – PGS, *Swedish Society for Nature Conservation*

Kansara, N.M. (1995) Agriculture and animal husbandry in the Vedas, *New Delhi*

Katyal, J.C. and Reddy, K.C.K (1997) Plant nutrient supply needs: Rainfed food crops. In Plant Nutrient Needs, Supply, Efficiency and Policy Issues: 2000-2025 (eds Dr.J.S.Kanwar and Dr.J.C.Katyal), *National Academy of Agricultural Sciences, New Delhi. pp. 91-113.*

Khosla R (2006) A Participatory Organic Guarantee System for India, *FAO International Consultant, Organic Certification Systems*

Kinda T., Patrick P. and Varoudakis M.A.V (2009) Firms' productive performance and the investment climate in Developing Economies: An application to MENA Manufacturing, *World Bank Policy Research Working Paper No.4869*

Kotschi, J. (2000) Poverty Alleviation in the South –Can Organic Farming Help*?*

Kramer, S.B., Reganold, J.P., Glover, J.D., Bohannan, B.J.M., Mooney, H.A. (2006): Reduced nitrate leaching and enhanced denitrifier activity and efficiency in organically fertilized soils. *Proceedings of the National Academy of Sciences of the USA 103, 4522-4527.*

Lakner Sebastian (2009) Technical efficiency of organic milk-farms in Germany – the role of subsidies and of regional factors, Paper prepared and presented at the *International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009*

Lampkin N H (1994) Economics of organic farming in Britain in Lampkin N.H and Padel S. (Eds) The economics of organic farming – An international perspective, *CAB International Publishers*

Lampkin, N.H (1994) "Organic farming: sustainable agriculture in practice" in Lampkin N.H and Padel, S (eds.) The economics of organic farming – An international perspective, *CAB International, Oxon (UK)*

Larsen K., Foster K., (2005) Technical efficiency among organic and conventional farms in Sweden 2000-2002: a counterfactual and self selection analysis. Paper presented at the *American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27.*

Lasalle T.J and Hepperly P (2008) Regenerative organic farming: A solution to Global Warming, *Rodale Institute, USA.*

Lovell, C.A.K (1993) "Production Frontiers and Productive Efficiency" In H.O Fried; C.A.K Lovell and S.S Schmidt (Eds.) "The Measurement of Productive Efficiency", *Oxford University Press, New York, Pp:3-67.*

Lovell, C.A.K (1994), "Linear Programming Approaches to the Measurement and Analysis of Productive Efficiency", *Top, Vol.2, Pp.175-248 .*

MacDonald D.M., (2004) Agri Impact Assessment Study for Organic Cotton Farmers of Kutch & Surendranagar. *Agrocel Industries Ltd. September 2004.*

Madau F., (2005) Technical efficiency in organic farming: an application on Italian cereal farms using a parametric approach. Proc. XI Congress *EAAE, August 24-27, Copenhagen, Denmark*

Mäder, P.; Fließbach, A.; Dubois, D.; Gunst, L.; Fried, P. & Niggli, U. (2002) Soil fertility and biodiversity in organic agriculture; *Science 296, 1694-1697*

Mahale, Prabha and Sorée, Hay (1999) "Ancient visions and new experiments of rural people", In *Food for Thought* (Bangalore, India Books for Change)

Mahale P (2002) "National Study: India", in PRUDD: Organic agriculture and Rural poverty alleviation – Potential and best practices in Asia, Population, Rural and Urban Development Division, *UNESCAP, Bangkok, Chapter 3, 73-97.*

Mayen C.D, Balajgtas J.V and Alexander C.E (2010) Technology adoption and technical efficiency: organic and conventional dairy farms in the United States, *American Journal of Agricultural Economics, Jan 21, 2010*

Milana C., Nascia L. and Zeli A. (2008) Changes in Multifactor productivity in Italy from 1998 to 2004: Evidence from firm-level data using DEA, *EU KLEMS Working paper series no.33, Pp: 1-21.*

Mazumder R. and Adhikary M. (2010) Measuring Technical Efficiency in the Indian Automobile Industry, *South Asia Economic Journal, Vol no.11 (1), Pp: 53-67*

Narayanan S (2005) Organic farming in India: Relevance, Problems and Constraints, *Occasional paper no.38, NABARD, Mumbai, India*

National Centre of Organic Farming (NCOF), Ghaziabad *(http://dacnet.nic.in/ncof/ accessed on 10th January, 2010)*

Niggli *et al* (2008) Vision for an organic food and farming: Research Agenda to 2025, *IFOAM and ISOFAR joint publication.*

Niggli, U., Fließbach, A., Hepperly, P. and Scialabba, N. (2009) Low Greenhouse Gas Agriculture: Mitigation and Adaptation Potential of Sustainable Farming Systems*. FAO, April 2009, Rev. 2 – 2009*

Offermann F., Nieberg H. (a cura di) (2000) Economic Performance of Organic Farms in Europe. Organic Farming in Europe. *Economics and Policy, Volume 5. Hohenheim, Universität Hohenheim.*

Olson K and Vu L (2007) Economic Efficiency and Factors Explaining Differences between Minnesota Farm Households, Paper prepared and presented at the *American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August 1, 2007*

Organic Agriculture, Environment and Food Security (2002), *FAO publication (ISBN: 9251048193)*

Oude lansink A., Pietola K., Backman S., (2002) Efficiency and productivity of conventional and orga nic farms in Finland 1994-1997. *Eur Rev Agr Econ 29, 51-65.*

Padel S and Uli Z (1994) Economics of organic farming in Germany, The economics of organic farming – An international perspective, Edited by Lampkin N.H and Padel S., *CAB International Publishers*

Parameswaran M. (2002) Economic Reforms and Technical Efficiency: Firm level evidence from selected industries in India, *Working paper 339, Centre for Developmental Studies, Thiruvanthapuram.*

Pereira, Winin, 1993. *Tending the Eart*h (Bombay, India, Earth care Books)

Pimentel, D (1995) Amounts of pesticides reaching target pests: Environmental impacts and ethics, *Journal of Environmental Ethics 8: 17-29.*

Pimentel D, Hepperly P, Hanson J, Douds D and Seidel R. (2005) “Environmental, energetic and economic comparisons of organic and conventional farming systems”, *Bio-science 55(7):573–582.*

Pimentel. D., (2006) Impacts of organic faming on efficiency and energy use in agriculture (www.organicvalley.coop/fileadmin/pdf/ENERGY_SSR.pdf)

Pingali P.L and Traxler G. (2002) Changing locus of agricultural research: will the poor benefit from biotechnology and privatization trends? *Food Policy, Vol.27, Pp: 223-238*

Qaim Martin (2005) Agricultural Biotechnology Adoption in Developing Countries, *American Journal of Agricultural Economics, Vol. 87, November, 2005, Pp: 1317-1324*

Chand Ramesh and S.S Raju (2008): “Instability in Indian Agriculture”, *Discussion Paper: NPP01/2008, National Centre for Agricultural Economics and Policy Research, Pusa, New Delhi.*

Ramesh, P, Mohan Singh and Subba Rao, A. (2005). Organic farming: Its relevance to the Indian context. *Current Science, Vol. 88, No.4. pp.561-568.*

Randhawa, M.S. (1986) *A History of Agriculture in India 1980-1986*, vol. I –IV, *Indian Council of Agricultural Research, New Delhi.*

Rao *et al*, (2006) The Market for Organic foods in India, *ICCOA publication, Bangalore, India.*

Rao, N Chandrasekhara and S Mahendra Dev (2009) “Bio-technology and pro-poor Agricultural Development” *Economic and Political Weekly, Vol no.52, December 26, Pp: 56-64*

Raj Kumar A. 2009 Economics of organic Vs inorganic Carrot production in Nepal, *The Journal of Agriculture and Environment*, Vol no.10, June 2009, Pp: 23-28

Ray, S.C and E. Desli (1997) “Productivity Growth, Technical Progress, and Efficiency Changes in Industrialized Countries: Comment”, *American Economic Review, 87, 1033-1039*

Reganold J P *et al* (1987) Long-term effects of organic and conventional farming on soil erosion, *Nature, Vol no.330, 26th November, 1987*

Reganold, J.P.; Elliot, L.F. & Unger, Y.L. (1987) Long-term effects of organic and conventional farming on soil erosion; *Nature 330, 370-372*

Rekha, S.N Naik and R.Prasad (2006) Pesticide residue in organic and conventional food-risk analysis, *Journal of Chemical and Health safety, November/December, 2006*

Report of Task Force on Organic Farming, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, 2001

Report of the Need Assessment of Indian Organic Agriculture (2004), *State Secretary for Economic Affairs (SECO) Publication*

Resti, Andera (1997) Evaluating the cost-efficiency of the Italian Banking System: What can be learned from the joint application of Parametric and Non-parametric techniques, *Journal of Banking and Finance, 21, Pp: 221-250*

Ross K., Dalton T.J and Featherstone A.M (2009) A non-parametric Efficiency Analysis of Bean Producers from North and South Kivu, Paper prepared and presented at the *Southern Agricultural Economics Association Annual Meeting, Atlanta, Georgia, January 31- Feb 3, 2009*

Rup Lal, Narayana Rao, V.S.S. and Krishnamoorthy V. (1989) Pesticide residues in food; An overview of studies undertaken in India. *In: Pesticides Residues in Food. Consumer Education Research Centre, Ahmedabad, P. 99*

Rupela O P (2008) Prosperity of small-holder farmers through Science-based Organic Farming Technology (SOFT) (Draft for discussion), *Consultant, FAO*

Sainath P (2010) Nearly two lakh farm suicides since 1997, *The Hindu, 22nd January.*

Salvador V.G and Jyoti K (2003) Market Opportunities and Challenges for India organic products, *SECO Study.*

Sanders Richard, (2006) A Market Road to Sustainable Agriculture? Ecological Agriculture, Green Food and Organic Agriculture in China. In: *Development and Change 37(1): 201-226. Institute of Social Studies 2006. Blackwell Publishing, USA.*

Seiford, L.M (1996) Data Envelopment Analysis: The evolution of the state of the Art (1978-1995), *Journal of Productivity Analysis, 7, Pp:99-138*

Seiford, L.M and Thrall R.M (1990) “Recent Developments in DEA: The Mathematical Programming Approach to Frontier Analysis” *Journal of Econometrics, 46, Pp: 7-38, North Holland*

Sharma P.D, (2003) Prospects of organic farming in India, in proceedings of National seminar on Organic products and future prospects, *Sher-e-Kashmir UAST, Srinagar, Pp: 21-29*

Sharma V.P and Hrima T (2009) Fertilizer subsidy in India: Who are the beneficiaries? *Working Paper, July, 2009*, *Indian Institute of Management, Ahmedabad, India*

Sharma, K.R, Leung, P., Zaleski, H.M (1999) “Technical, allocative and economic efficiencies in Swine Production in Hawaii: A comparison of Parametric and Non-parametric Approaches, *Agricultural Economics, 20, Pp: 23-35*

Sharma, V.P and Sharma P (2002) Trade liberalization and Indian Diary Industry, *CMA Monograph no.196, IIM, Ahmedabad, Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi.*

Shephard, R.W (1970) "Theory of cost and production functions", *Princeton University Press, Princeton*

Shetty P.S. (2002) Nutrition transition in India. *Public Health Nutr*, 5(1A): 175-82

Shirsagar KG 2008 Impact of organic farming on economics of sugarcane cultivation in Maharashtra, *Working paper no.15, Gokhale Institute of Politics and Economics, Pune*

Shiva V *et al* (2000) Seeds of suicide, *Navdanya Publicaitons, New Delhi*

Shiva V *et al* (2001) Corporate hijack of Agriculture, *Navdanya Publicaitons, New Delhi*

Shiva V *et al* (2004) Principles of Organic farming: Renewing the Earth's Harvest, *Navadanya Publications, New Delhi*

Siegrist, S.; Staub, D.; Pfiffner, L. & Mäder, P. 1998. Does organic agriculture reduce soil erodibility? The results of a long-term field study on loess in Switzerland. Agriculture, *Ecosystems and Environment 69, 253-264.*

Singh S. (2009) Organic produce supply chains in India: Organization and Governance, *CMA publication no.222, IIM, Ahmedabad – 380015*

Singh S. (2004) Marketing of Indian Organic Products: Status, Issues and Prospects, *Working Paper, Indian Institute of Management, Ahmedabad, 380015*

Singh J, G.P Singh and Rajkishor 2006 Present status and Economics of organic farming in the district of Udham Singh Nagar in Uttaranchal, *Agricultural Economics Research Review*, Vol no.19, Pp: 135-144

Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko (2007): Agriculture. In Climate Change (2007): Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], *Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA*

Stoll, G. 2002 Regional overview: Asia and the International context, in PRUDD: Organic agriculture and rural poverty alleviation – Potential and best practices in Asia, Population, Rural and urban Development Division, *UNESCAP, Bangkok*

Stolze, M., Piorr, A., Haring, A., Dabbert, S. (2000) The Environmental Impacts of Organic Farming in Europe – Organic Farming in Europe: *Economics and Policy, vol. 6. University of Hohenheim, Stuttgart.*

Subhash C R (2004) Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research, *Cambridge University Press*

The Economics of Organic farming: An International Perspective (eds) (1994) by Lampkin and Padel, *CAB International.*

Thorup-Kristensen, K., Magid, J. and Jensen, L.S. (2003) Catch crops and green manures as biological tools in nitrogen management in temperate zones. *Advances in Agronomy 79, 227-302.*

Tzouvelekas V., Pantzios C.J., Fotopoulos C. (2002b). Empirical Evidence of Technical Efficiency Levels in Greek Organic and Conventional Farms, *Agricultural Economics Review* 3: 49-60.

Tzouvelekas V., Pantzios C.J., Fotopoulos C., (2001a) Technical efficiency of alternative farming systems: the case of Greek organic and conventional olive-growing farms. *Food Policy 26, 549-569.*

Tzouvelekas V., Pantzios C.J., Fotopoulos C., (2001b) Economic efficiency in organic farming: evidence from cotton farms in Viotia, Greece. *J Agr Appl Econ 33, 35-48.*

Tzouvelekas V., Pantzios C.J., Fotopoulos C., (2002a) Measuring multiple and single factor technical efficiency in organic farming. *Brit Food J 104, 591-609.*

van der Werf, E. and A. de Jager (1992) "Ecological agriculture in South India: an agro-economic comparison and study of transition", *LEI/DLO & ETC-Foundation, the Netherlands*

Vanloon G.W, S.G Patil and L.B Hugar (2005) Agricultural Sustainability: Strategies for Assessment, *Sage Publications, New Delhi*

Venkateswarlu (2005) Organic farming in Rain fed Agriculture: Opportunities and Constraints, Paper presented at the National Seminar on National Policy on Organic Farming, NCOF, *Ghaziabad, 10-11 March, 2005*

Wheelock, D.C and P. Wilson (1999), "Technical Progress, Inefficiency, and Productivity Change in U.S Banking, 1984-1993", *Journal of Money, Credit and Banking, 31, 212-234*

World Commission on Environment and Development Report (1987), *United Nations.*

Worthington M K (1980) Problems of Modern Farming, *Food Policy, August issue, 1980.*

Worthington V (2001) Nutritional quality of organic versus conventional fruits, vegetables and grains. *The Journal of Alternative and Complementary Medicine 7(2): 161-173.*

www.tradingeconomics.com (accessed on 20th January, 2010)

Wynen E (1994) Economics of organic farming in Australia, The economics of organic farming – An international perspective, Edited by Lampkin N.H and Padel S., *CAB International Publishers*

Yusuf S.A and O.Malomo (2007) Technical efficiency of poultry egg production in Ogun State: A Data envelopment analysis approach, *International Journal of Poultry Science, 6 (9), Pp:622-629*

Zofio, J., and C.A.K Lovell (1999) “Yet another Malmquist Productivity Index Decomposition” Mimeo, Department of Economics, *University of New South Wales, Sydney*

****

Appendix

Table 1 TE, AE and EE of sample units under both CRS and VRS Model of DEA analysis (%)

	DEA-CRS Model			DEA-VRS Model			SE
Unit no	TE	AE	EE	TE	AE	EE	
1	50.0	18.5	9.2	100.0	38.2	38.2	50.0
2	50.0	18.5	9.2	100.0	38.2	38.2	50.0
3	50.0	18.5	9.2	100.0	38.2	38.2	50.0
4	50.0	18.5	9.2	100.0	38.2	38.2	50.0
5	100.0	33.9	33.9	100.0	36.8	36.8	100.0
6	100.0	33.9	33.9	100.0	36.8	36.8	100.0
7	48.6	31.2	15.2	100.0	75.7	75.7	48.6
8	37.5	23.5	8.8	100.0	89.4	89.4	37.5
9	37.5	72.7	27.3	100.0	98.0	98.0	37.5
10	34.7	34.2	11.9	44.6	30.8	13.8	77.8
11	56.2	55.6	31.3	100.0	88.0	88.0	56.3
12	37.5	62.1	23.3	100.0	68.6	68.6	37.5
13	62.5	85.3	53.3	73.9	81.4	60.2	84.6
14	82.5	28.9	23.8	83.9	29.3	24.6	98.3
15	82.3	56.8	46.7	83.4	64.8	54.0	98.7
16	80.4	26.2	21.0	80.5	26.4	21.3	99.9
17	50.0	58.3	29.1	72.4	87.7	63.5	69.0
18	68.3	68.3	46.6	69.6	67.8	47.2	98.2
19	37.5	57.8	21.7	83.0	69.6	57.8	45.2
20	56.2	52.0	29.2	83.5	63.9	53.4	67.4
21	25.4	45.4	11.5	77.5	39.8	30.9	32.7
22	100.0	100.0	100.0	100.0	100.0	100.0	100.0
23	44.1	82.5	36.4	63.6	87.4	55.6	69.4
24	46.7	92.1	43.0	53.4	80.9	43.2	87.4
25	80.7	49.5	39.9	81.6	51.5	42.0	98.9
26	79.2	55.1	43.6	80.6	59.0	47.6	98.2
27	79.6	53.3	42.4	80.8	55.8	45.1	98.5
28	71.0	25.6	18.2	75.4	30.5	23.0	94.2
29	100.0	98.7	98.7	100.0	100.0	100.0	100.0
30	100.0	19.3	19.3	100.0	24.8	24.8	100.0
31	40.5	64.4	26.1	46.4	65.8	30.5	87.4
32	40.5	64.4	26.1	46.4	65.8	30.5	87.4
33	40.5	43.8	17.8	45.8	43.8	20.1	88.5
34	40.5	43.8	17.8	45.8	43.8	20.1	88.5
35	75.0	12.8	9.6	81.8	16.3	13.4	91.7
36	75.0	12.8	9.6	81.8	16.3	13.4	91.7
37	100.0	88.7	88.7	100.0	100.0	100.0	100.0
38	37.5	88.8	33.3	100.0	62.9	62.9	37.5
39	100.0	71.1	71.1	100.0	82.3	82.3	100.0
40	100.0	71.1	71.1	100.0	82.3	82.3	100.0

Photographs of vermi-hatchery units in Gujarat state

Photographs of vermi-hatchery units in Maharashtra state

Photographs of vermi-hatchery units in Punjab state