

ADOPTION OF SUSTAINABLE SUGARCANE
FARMING PRACTICES BY FARMERS
- AN ANALYSIS

M.T. LAKSHMINARAYAN



DEPARTMENT OF AGRICULTURAL EXTENSION
UNIVERSITY OF AGRICULTURAL SCIENCES
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M.T. LAKSHMINARAYAN

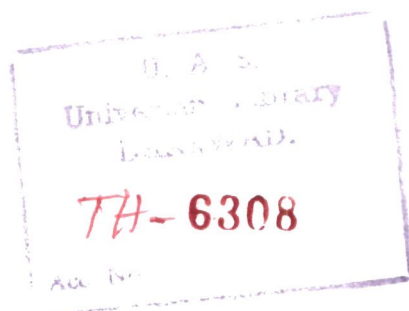


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CERTIFICATE

This is to certify that the thesis entitled "ADOPTION OF SUSTAINABLE SUGARCANE FARMING PRACTICES BY FARMERS - AN ANALYSIS" submitted by Mr.M.T. LAKSHMINARAYAN, for the degree of DOCTOR OF PHILOSOPHY in AGRICULTURAL EXTENSION to the University of Agricultural Sciences, Bangalore, is a record of research work done by him during the period of his study in this University under my guidance and supervision and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship and other similar titles.

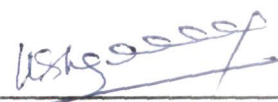
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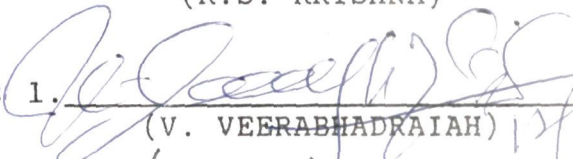
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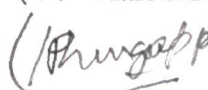
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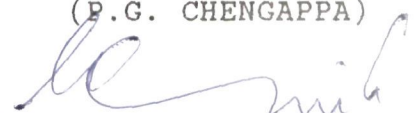
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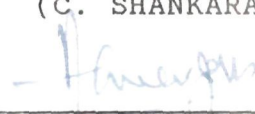
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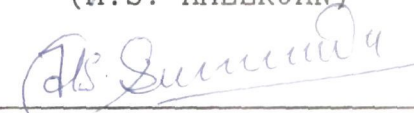
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(M.S. AMEERJAN)

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(M.T. LAKSHMINARAYAN)

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INTRODUCTION

CHAPTER I

INTRODUCTION

In a predominantly agricultural country like India where about 65 per cent of the population depends on agriculture for their livelihood, agricultural production holds the key to the peace, progress and prosperity of the nation. While the population and the demand for agricultural production are increasing rapidly, the scope for bringing more land under cultivation is receding fast. The demographers have warned that the world population would reach 500 crores and that of India 100 crores by 2000 AD. India is required to produce 225 million tonnes of foodgrains by the end of this century to feed its 100 crores population. This has forced us to explore and evolve means to face the challenges of nature to meet food for the future.

In the process of increasing agricultural production, the rich natural resources like land, water, forests and minerals are mindlessly exploited to meet the human needs of the growing population. The unmindful degradation of natural resources and consequences of this act on environment is resulting in human misery. Now, the governments have opened up their minds and are realizing the hazards of unsustainable agriculture in the long run.

A lot of emphasis has been laid on the commercialization of agricultural production. An effort has been made to

commercialize agriculture through the introduction of high yielding varieties, chemical fertilizers, pesticides, irrigation and mechanization. These components were introduced without taking their side effects into account. Agricultural planners made it that their only aim is to increase production. While on the one hand, commercial agriculture increases the yield, it damages the environment and increase inequality in the society, on the other.

For nearly four decades after the World War II, the United States agriculture was the envy of the world almost, annually, setting new records in crop production and labour efficiency. During this period, United States farms became highly mechanized and specialized, heavily dependent on fossil fuels, borrowed capital as well as chemical fertilizers and pesticides. Today, the same farms are associated with declining soil productivity, deteriorating environmental quality, reduced profitability and threats to human and animal health (Anonymous, 1996a).

In order to meet the food needs of the alarmingly growing population in India, "Green Revolution" came as an answer in 1964-65, with the introduction of high yielding varieties of various kinds of crops. The objective of increased food production was emphasized through increased mechanization, increased water exploitation by irrigation schemes, use of large amount of chemicals as fertilizers and

pesticides, and encouragement of cash crops to meet the market needs.

The major achievements of the Green Revolution were increased production and productivity in a shorter duration. People engaged in agribusiness reaped high profits and the bureaucrats gained more powers. But the farmers were forced to become heavily dependent on purchased external inputs like high yielding variety of seeds, fertilizers, pesticides, fungicides, weedicides, fossil fuels, electricity, machineries and technical knowledge of the experts. As a result, farmers were entangled to go in for capital intensive agriculture which went beyond the control of the farmers due to excessive dependency on outside factors.

Over the years, increased use of fertilizers and pesticides has adversely affected the environment and has caused serious ill effects to man, animal and plant health. Research reports show that residual contents of pesticides in various food items are above the permissible limits. Some of the ill effects perceived in modern agriculture over the years are : (1) loss of sustainability of soils, (2) increased cost, (3) increased resistance of weeds and insects to weedicides and pesticides, (4) environmental hazards, (5) loss of plant genetic variability, (6) acid rains, green house effect, ozone layer depletion etc., and (7) external dependency of farmers to technology and loans.

The sustainability of intensive agriculture with adoption of modern technology and inputs is in great doubt because of the associated problems of soil degradation, pesticide accumulation, poor water management, gene erosion, and atmospheric and water pollution (Anonymous, 1996b).

Ramesh (1994) emphasizing the importance of sustainable agriculture said "The limitations of modern agriculture have been recognized by farmers and scientists all over the world. Efforts are being made to identify alternative farming methods which are ecologically sound, economically viable, socially just and culturally appropriate. Such efforts made by farmers and scientists, to identify alternative farming methods, which are less dependent on purchased inputs has led to what is called "Sustainable agriculture". It is being reported that farmers who have adopted such alternative farming methods are getting yields on par with the modern agriculture without the major inputs of modern agriculture, namely, chemical fertilizers, insecticides and use of machinery.

Sustainable agriculture embraces several variants of non-conventional agriculture that are often called organic, alternative, regenerative, ecological, natural, bio-dynamic farming and the like.

According to Singh et al. (1990) "Sustainable agriculture is one which makes use of low cost inputs, less

amount of chemical fertilizers, maintains soil fertility and ecological harmony. Further, these should maintain or increase the biological productivity".

Mehta (1995a) delineated Sustainable Agriculture with the following practices to maintain or increase in production.

1. A central component of almost all sustainable farming practices is changing over from monoculture to multi-culture i.e., intercropping, crop rotation, etc.

2. Selection of quality seed material and adopting timely cultural operations like sowing, fertilization, harvesting etc.

3. Regular adding of crop residues, manure and other organic materials to the soil.

4. A sustainable farm invariably uses legume as a cover crop and green manure.

5. Synthetic substances like chemical fertilizers, hazardous pesticides, weedicides should be reduced, and

6. The integrated pest management involves growing disease resistant varieties and biological controls such as natural predators or parasites that keep the pest population below injurious levels.

Shashikumar (1994) stated that "Soil is a basic resource for agriculture. It is a nature's gift to mankind. Nature protects the soil with dense cover of trees and grasses. But man has disturbed the balance among soil, water and plant by excessive use of hazardous fertilizers and pesticides to get increased production resulting in deterioration of soil fertility and health. This situation has led to decreased agricultural production. Maintenance and improvement of soil fertility by the adoption of ecofriendly technologies to get increased and sustained crop yields should be resorted to, because of heavy population growth and their increasing demand for food, fibre and fuel. Since we inherit soil, it is our social responsibility to protect the land for future generation and their survival on earth. Further, it is said that soil has life. By applying chemicals we are killing the microbial activity in the soil, thus rendering it dead".

Nagarajan (1992) while discussing about sustainable sugarcane farming revealed that :

1. Ploughing by making use of bullocks, would not only reduce soil compaction but also reduce the dependency on external input (fossil fuel) used by tractor to plough land.

2. Adopting low or high seed rate (setts) than the optimum would result in reduced population and wastage of

seed material, respectively. Seed rate according to the spacing and the variety is highly essential for maintaining good yields, likewise proper time and method of sowing depending upon the variety is also important or otherwise, it would result in reduction in cane and sugar yields. These are non cash and low cost inputs/technologies.

3. There is a tendency to increase in ratoon cane area due to increase in price of inputs and labour and farmer treats ratoon crop as a free crop. Time of ratooning, and specific operations like stubble shaving, shoulder breaking etc., are important to decide the growth span of the crop and obtain sustainable yield.

4. Determining the maturity of the cane and deciding upon the time and method of cane harvest are important to get sustainable cane yields.

Muthuraman (1995a) summarized that "Success in promoting sustainable agriculture can be achieved through genetic diversity, crop diversification, integrated nutrient management, integrated pest management, and sustainable water management".

Genetic diversity emphasis on location specific varieties which are essential for achieving sustainable advances in providing productivity. Diversity of crop varieties is a resultant of plant breeding efforts done

according to the needs of rural families for enhancing the stability of yield.

Crop diversification methods like crop rotation, intercropping, mixed cropping, and double cropping reduce soil erosion, improve soil fertility and increase yields. Legumes grown in crop rotation and grown as an intercrop would reduce the need for nitrogenous fertilizer.

Integrated nutrient management has several components viz., applying fertilizers, farm yard manure, compost, crop residues, green manures, rhizobium, blue green algae, azolla besides efficient crop management practices. The major steps in integrated nutrient management are : (1) appropriate cropping systems, (2) soil testing, (3) agronomic techniques like split application of fertilizers, methods and placement of fertilizers, and use of combination of organic and inorganic manures, (4) use of green manures, (5) conjunctive use of farm wastes, (6) selection of appropriate variety and optimum cultural practices, and (7) adoption of water management techniques including maintenance of farm drains.

Integrated pest management in agriculture is ideally the most effective, economical, safest, ecologically sustainable and socially acceptable combination of physical, chemical and biological methods to limit the harmful effects of crop pests. A number of tools or components have been

successfully used for integrated pest management in several crops. These include : (1) use of pest resistant varieties, (2) cultural practices like early or late planting, summer ploughing, etc. (3) use of parasites, predators and pathogens of crop pests, (4) quarantine measures, and (5) judicious use of pesticides, attractants, repellents, sterilants, growth regulators, male sterile techniques and suppression programmes.

Sustainable water management is possible when water is efficiently utilized and managed to achieve better crop production and productivity. This can be achieved by judicious use of water, supply of irrigation water on volumetric basis for economic use, water harvesting in command areas, proper design and management of irrigation system to prevent salinization, and development of environmentally sound low cost medium scale dams.

Sugarcane is one such crop where there is lot of scope to incorporate the above said practices, systematically to harvest higher yields and to maintain soil productivity although it is a very exhaustive crop. Oflate, sugarcane scientists in particular and agricultural scientists in general are overwhelmingly advocating the sustainable package of practices to harvest good tonnage in sugarcane.

Sugarcane is one of the most important cash crops in India. India ranks first among sugarcane growing countries

of the world, both in area and production. However, the productivity (69 tons per hectare) is stagnant for the last three years and is far below compared to the productivity (140 to 150 tons per hectare) of underdeveloped South African countries like Ethiopia, Kenya, Tanzania and Zimbabwe (Anonymous, 1996c).

Sugarcane is a very exhaustive crop. In order to boost production farmers use more of fertilizers, pesticides, weedicides and water in large quantities. Deliberate use of these purchased inputs has resulted in declining soil fertility and reduced yields over the years. Now, the farmers are realizing that their basic resource i.e., soil is spoiled and it needs to be replenished. Fertilizers and chemicals have killed the microbial activity in the soil leaving it dead. Indiscriminate use of water has rendered the soil saline and alkaline preventing drainage and biological activity in the soil. Farmers are motivated to rectify the imbalance and look for sustainable practices which can maintain the soil fertility intact and at the same time increase productivity.

In order to keep pace with increasing demand for sugar for internal consumption and exports, Karnataka has a greater role to play in contributing its share to country's sugar production. Among the States, Karnataka stands third both in terms of hecterage and production, and second in terms of

productivity (88 tons per hectare). The fact that the productivity of sugarcane crop is stagnating over the decade has been causing great concern to Government, because the stagnation/decline in productivity implies that massive investments made in the field of agriculture, irrigation and related areas during the five year plans have not yielded desired net benefit either to the farmers or to the economy through increase in per hectare yield (Hanumarangaiah, 1996).

Nagarajan (1992) in an interview with innovative farmer reported that "It is the sugarcane crop where maximum number of sustainable technologies can be adopted (compared to any other crop) by following low cost and non cash technologies (selection of disease free setts, timely operations etc.), organic manures, biological control of pests, water management, ratoon management and timely harvest. By following these sustainable technologies one can reduce the cost of production as well as obtain sustained high yields upto 135-140 tons per hectare".

Considering the importance of sustainable practices in increasing the tonnage of sugarcane crop without any damage either to the soil or to the environment, scientists have been advocating a good number of practices for general adoption by the farmers of Karnataka, particularly in Cauvery Command Area. In spite of educational efforts, it is observed that there has been a slow adoption of these practices by the

farmers. Further, they put forward many difficulties to do it although a few farmers adopt them here and there.

There is a wide gap between the available sustainable sugarcane technologies and its application in farmers' field. This study addresses itself to find out the gap to develop suitable extension strategy to bridge the gap in the interest of resource base and environmental pollution.

With this background, the study is taken up to know the level of adoption of sustainable farming practices by sugarcane farmers and to find out the relationship between adoption levels and their personal, behavioural, motivational, situational and extension factors.

The specific objectives of the study are :

1. To develop an index to measure the package of sustainable practices in sugarcane.
2. To find out the extent of adoption of sustainable sugarcane farming practices.
3. To find out the relationship between the adoption levels of sustainable sugarcane farming practices of farmers and their personal, behavioural, motivational, situational and extension factors.
4. To discriminate the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices.
5. To find out the components contributing to sustainable sugarcane farming as perceived by farmers.

Scope of the study

The study would be of great help to identify the different sustainable sugarcane farming practices. In the process, the reasons for low sustainability could be analyzed and necessary corrective measures can be suggested to overcome those lacunae.

The study also aims to delineate the differential characteristics of farmers who are practicing more sustainable sugarcane farming practices and farmers who are practicing less sustainable sugarcane farming practices. This would give ample opportunity for the extension workers to manipulate/promote those factors while educating sugarcane farmers.

Limitation of the study

Basically the study was handicapped to the extent that it was a single student venture and the associated constraints like time, fund and physical facilities remained. In spite of this, the researcher has made valiant efforts to select a representative sample for the study so that the results of the study could be generalized to similar situations elsewhere.

Operational definitions/meanings of the concepts used in the study

Sustainability of sugarcane farming

It is the degree to which the farmers manage soil and water relying mainly on 'on farm' resources (i.e., the use of locally available resources, non cash and low cost inputs/ technologies, and minimizing the use of chemicals) to maintain or enhance productivity without affecting the production environment.

Land preparation

Refers to ploughing the land and preparing the land to plant canes in ridges and furrows.

Seeds (setts) and sowing

Includes non cash and low cost technologies in the selection of good quality setts and adopting recommended spacing.

Sugarcane based cropping system

Refers to practicing crop rotation and intercropping in sugarcane fields.

Integrated nutrient management

Extent of application of right quantity of organic and inorganic fertilizers and amendments to soil at proper time,

method and combination aimed at deriving maximum benefits and causing minimum damage to the resource base.

Water management

Extent of application of practices to obtain added benefits from rainfall and water flow through irrigation to store water in soil for crop production with proper drainage to keep the soil health intact.

Integrated pest management

Refers to management of pests (insects, diseases and weeds) by using preventive and curative measures through judicious combination of cultural, mechanical, biological and chemical means.

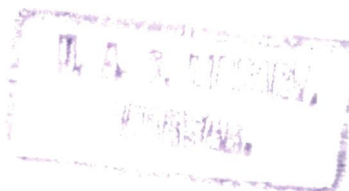
Ratoon management

Ratoon refers to subsequent harvesting taken from the cane stubble after first harvesting. Cultivation practices for ratoon crop includes all the practices as applied to main crop except land preparation and planting setts.

Maturity and Harvesting

Includes practices like judging maturity of the crop, adopting right time and correct method of harvesting the crop.

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Presentation of the study

The first chapter deals with the introduction wherein the objectives of the study are presented. It also throws light on the scope and limitations of the study.

The second chapter, via review of literature, deals with the review of available and related studies in the field of the present study.

The third chapter presents the methodology developed for the study. The location of the study area, sampling procedure followed, quantification of the variables selected for the study, procedure involved in test construction, statistical tests employed etc., are dealt in this chapter.

The fourth chapter contains the results of the study, followed by the fifth chapter viz., discussion, in which the results of the study are discussed.

The sixth chapter summarizes the findings of the study with a brief resume and implication of the findings.

The seventh and the last chapter indicates the references and appendices.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to report the findings and views of previous investigators on different aspects of the study in the light of the objectives set-forth. As the proposed research is quite new one in its subject treatment, the previous studies on this aspect were rather scarce or limited. However, to augment this scarcity a closely related research findings are reviewed. The literature review on different dimensions of the topic under study, is presented under the following heads :

- 2.1 The concept of sustainable agriculture
- 2.2 Components of sustainable agriculture and studies relating to it
- 2.3 Benefits in practicing sustainable agricultural technologies
- 2.4 Personal, behavioural, motivational, situational and extension factors and adoption of agricultural technologies
- 2.5 Problems faced in the adoption of sustainable agricultural technologies.

2.1 The concept of sustainable agriculture

The science and practice of Sustainable Agriculture is as old as the origin of agriculture itself, although the contemporary use of the term is evolved more recently.

Sustainable agriculture can be defined as integrated systems of agriculture production that are less dependent on high inputs of energy and synthetic chemicals (Edwards, 1987).

Ainsworth (1989) stated that "What is sustainable agriculture after all? The only sustainable agriculture is profitable agriculture - short and sweet".

The Technical Advisory Committee of the Consultative Group on International Agricultural Research defines sustainable agriculture as that which involves the successful management of resources for agriculture to satisfy changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources (Consultative Group on International Agricultural Research, 1989).

The practice of sustainable agriculture is concerned with achieving consistent increase in productivity in harmony with the principles of resources conservation (Keenay, 1989).

Sustainable farming can be defined as one that fulfills both the current needs of the farmers in terms of providing the farm family with sufficient food to survive and/or producing a cash surplus yet, at the same time, it does not destroy the future generations. On a basic level, sustainability is living within one's means (Anonymous, 1990).

Ecological agriculture means a viable alternative to the present unhealthy agricultural production system, which relies on external inputs such as chemical fertilizers and pesticides (Francis, 1990).

Francis and Youngberg (1990) were of the view that sustainable agriculture is a philosophy based on human goals and understanding of the long term impact of our activities on the environment and on the species.

The terms 'Organic Farming' was first used by Lord North Bourne and the phrase 'Sustainable Agriculture' was coined by Lady Eve Balfour (Rodale, 1990).

The definition of sustainable agriculture adopted by the American Society of Agronomy is the one that over the long term enhances environmental quality and the resources base on which agriculture depends, provides for basic human food and fibre needs, is economically viable and enhances the quality of life for farmers and society as a whole (Shaller, 1990).

Allen et al. (1991) defined sustainable agriculture as the one that equitably balances the concerns of environmental soundness, economic viability and social justice among sectors of the society.

Conway et al. (1991) opined that sustainable agriculture implies less specialized farming, often requiring mixed

crop/livestock farming for less dependence upon outside inputs.

Sustainable agriculture can be defined as "the management and conservation of the resources base and the orientation of technological and institutional changes in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (Food and Agriculture Organization, 1991).

Neher (1992) defined sustainable agriculture as an agriculture that can contribute towards greater human utility, greater efficiency of resource use and a balance with the environment that is favourable to humans and to most other species.

Non-Governmental Organisation Sustainable Agriculture Treaty (Anonymous, 1993) lays the following principles for sustainable agriculture. They are : (1) agriculture is sustainable when it is ecologically sound, economically viable, socially just and culturally appropriate, (2) sustainable agriculture preserves bio-diversity, conserves and improves the chemical, physical and biological qualities of the soil, and (3) sustainable agriculture uses locally

available resources, minimizes the use of external and purchased inputs, thereby, increasing local independence and self-sufficiency.

Sustainable agriculture refers to low inputs farming without damaging the resource base like land, water, forestry, etc. (Krishna, 1995).

Maskey (1995) opines that sustainable production system should be based on sound economic principles in lieu of a purportedly inevitable low input production system.

Sustainable agriculture embraces several variants of non-conventional agriculture that are often called organic, alternative, regenerative, ecological or low-input. For farm to be sustainable, it must produce adequate amounts of high quality food, protects its resources and be both environmentally safe and economically profitable. Instead of depending on purchased materials such as chemical fertilizers and pesticides, a sustainable farm relies on beneficial natural process and renewable resources drawn from the farm itself (Mehta, 1995b).

Sustainable agriculture should lead to increased farm productivity, while ensuring future security and less risks to the environment (Nataraju and Venkataranganaika, 1995).

Paroda (1995) defined sustainable agriculture as the appropriate use of crop and livestock systems and the

agricultural inputs supporting their activities which maintain economic and social viability, while preserving the high productivity and quality of the land.

Anonymous (1996b) defined sustainable agriculture as agricultural production and peasant livelihood that contributes to the rehabilitation and maintenance of ecological balance and the environment, with just economic returns, promoting a better quality of life for farmers and consumers and fostering the development of local institutions for the benefit and survival of all human kind.

Sustainability of paddy farming is defined as the extent to which farmer manages soil and water relying mainly on onfarm organic resources to enhance productivity and maintain it to meet the farm and family needs without affecting the production environment (Chandregowda, 1996).

Krishna and Narayanaswamy (1996) defined sustainable agriculture as the management and conservation of the resource base, the orientation of technological and institutional changes in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and future generations. Such sustainable development is environmentally friendly, technically appropriate, economically viable and socially acceptable.

Farming can cause ecological damage or improve it through abuse or judicious use of soil and water. To be economically viable, it should give secured returns, enhanced yield per unit area and per unit of investment. To be socially just and humane, farming should offer sufficient food to the depending members of the family, should be done within the naturalistic and non-naturalistic inputs possessed by the farm family. While doing so, the production environment has to be safeguarded which implies protection of the air, water, natural predators and decomposition of soil organic matter. This can be achieved through judicious use of pesticides and chemicals.

On this very foundation, the present operational definition of "Sustainability of Sugarcane Farming" has been arrived at.

2.2 Components of sustainable agriculture and studies relating to it

As there were very few studies on sustainable technologies/components in sugarcane cultivation, studies on similar crops have been reviewed along with that of sugarcane.

According to Swaminathan (1991) there are nine basic principles promoting sustainable agriculture, namely, land, water, energy, nutrient supply, genetic diversity, pest management, postharvest system, system approach, location specific research and development.

Bhaskar and Ashok (1993) said that practicing natural farming was better since modern agricultural practices had some problems like, (1) dependence on external inputs, (2) all types of insects are killed by chemical spray, (3) lesser gross profits, (4) no guarantee of yields, (5) time consuming because of various cultural practices and (6) low cost benefit ratio.

Hulagur (1994) revealed that majority of the farmers in both ragi and sugarcane based farming systems belonged to medium category of efficiency in production.

Maskey (1995) identified certain factors responsible for sustainable production. They are : (1) research on diversification strategies, i.e., crop rotation, mixed cropping, biological nitrogen fixation, soil tillage, etc., (2) use of low-input production system i.e., lowering per unit expenditure on production inputs, (3) increasing output per unit of input, (4) producing more profitable crops, and (5) making better use of available land and other resources.

Muthuraman (1995) reported nearly 40 per cent of Andhra Pradesh farmers were medium adopters of farm yard manure, while 30 per cent of farmers belonged to each of the other two viz., low and high adopter categories.

Sujatha et al. (1995) reported that pulling and removing the diseased cotton plants was followed by 65.5 per

cent of Tamil Nadu farmers as an integrated pest management practices, followed by using sex pheromone traps (30 per cent), hand picking of egg masses/larva from the infected plants (22.5 per cent) and using light traps (20 per cent).

According to Surekha and Rao (1995) the important components of integrated nutrient supply system are : (1) fertilizers, (2) organic manures, (3) agro-industrial wastes, (4) crop residues, (5) green manures, (6) legumes in cropping system, and (7) biofertilizers.

Anonymous (1996b) observed that to maintain soil fertility, farmers of plain and hilly regions of Karnataka State were practicing application of farm yard manure, chemical fertilizers, green manuring, biofertilizers, use of compost, silt, oil cakes, and soil and water conservation practices.

Chandregowda and Jayaramaiah (1995) found that relatively better nutrient management was noticed among rainfed lowland rice farmers of Coorg district than the irrigated rice farmers of Mandya district in Karnataka State.

To overcome the harmful effects of modern farming using fertilizers and chemicals, most of the farmers had started systematic crop planning and animal husbandry. This not only helps to meet the requirements of organic matter but also supplies milk and in some cases farmers use cattle urine

mixed with biopesticides to combat pests and diseases (Hanumappa and Rajendran, 1996).

Iqbal et al. (1996) revealed that more than half of the farmers (51 per cent) of Tamil Nadu State were found to be having medium level of adoption of recommended integrated pest management practices in cotton.

Krishna and Narayanaswamy (1996) indicated that a majority of extension workers agreed that sustainable technologies like integrated pest management, green manuring, crop rotation, biofertilizers and agro-forestry were eco-friendly and improve soil fertility.

High organic matter addition to soil, a necessary condition to sustainable organic farming, will not necessarily lead to high organic matter status of soil or concomitant high soil fertility and crop yields. These are governed by rates of organic matter decomposition, nutrient cycling, proper timing of organic matter addition, uptake and losses, etc. (Nagaraja et al., 1996).

Patil et al. (1996) revealed that by releasing Trichogramma chilonis, an egg parasite at the rate of 2.5 lakhs per hectare in five installments starting from 30 days after sugarcane planting and at an interval of 10 days were found effective for the control of early shoot borer.

Important sustainable organic farming practices followed by Karnataka farmers were (1) perennial cropping system, (2) animal husbandry practices, (3) gradual reduction in the use of external inputs, (4) least disturbance of soil i.e., zero tillage, (5) crop residue management, (6) use of bio-products made out of local or onfarm resources, and (7) several indigenous methods to meet the challenges for stability in yields and productivity (Ramesh and Jayaramaiah, 1996).

Nearly cent per cent of the farmers of Gulbarga district had adopted summer deep ploughing and proper time of sowing as cultural measures to control pests in redgram (Shivaraj, 1996).

It could be inferred from the above studies that non cash and low cost technologies, use of farm yard manure, compost, biofertilizers, silt, green manure, integrated nutrient management practices, integrated pest management practices and soil and water conservation practices were the important components of sustainable agriculture practiced by the farmers. There is a wide gap between the available sustainable technologies and its application on the field by majority of the farmers. However, only a few studies have been reported on sugarcane. Hence, it would be interesting to study the adoption pattern of sustainable sugarcane practices by farmers.

2.3 Benefits in practicing sustainable agricultural technologies

Aswathaiah et al. (1975) reported that in the case of hybrid jowar, the practices which did not involve more cost and which were simple to adopt were adopted by majority of the farmers.

Rotti (1983) revealed that majority of the sugarcane farmers had followed the low cost and simple sustainable technologies like sowing time, seed rate, spacing, variety, application of farm yard manure and inter-cultivation practices. Similar findings were observed by Mahadevaiah (1987), Patel et al. (1993) and Wasnik (1993).

Ganapathi (1991) reported that organic farming practices were economical and yielded steady returns over a period of years.

Kate (1991) measured the requirement of water by coconut trees which revealed that one coconut tree required 140 to 150 litres of water a day in the conventional method compared to 40 to 50 litres in drip irrigation method and 15 to 20 litres in natural farming method which speaks of resource efficiency on farm.

Manindral (1991) the manager of Gloria land, 40 hectare organic farm of Sri Aurobindo Ashram, Pondicherry reported that "Ecological farming is a self-reliant method and it has

to be an integrated system. It is a knowledge practice, and one has to constantly keep pace with dynamics of nature to increase the biological activity of the soil. Highly efficient method of organic recycling and crop protection using indigenous practices have been yielding good results".

Raju (1991) concludes that natural farming provides better health and happiness to those who practice it. Thus, it paves way for better life.

Tangaswamy (1991) observed that natural farming practices improve soil health. The crops grown with rich organic manure resist pest and disease attack. It is an ecologically sound and sustainable way of growing more food.

Nagarajan (1992) reported that according to Mr.Prafullchandra (an innovative sugarcane farmer of Shimoga in Karnataka State), the following advantages could be derived from using sugarcane leaf trash to ratoon crop :

1. Mulching trash saves cost on use of chemical fertilizers.
2. The converted trash acts as a soil cover, which inhibits weed growth. The rich organic manure also increases the yield of next crop.
3. Loss of water by evaporation is prevented, thus, saving about 50 per cent of irrigation water, and

4. The method helps saves a minimum of Rs. 2500 per hectare [Saving nearly 15 cartloads of farm yard manure (Rs.1500), minimizing use of fertilizers (Rs. 500) and eliminating weeding cost (Rs. 500)].

Very little cost, easy to release parasites in the grown up sugarcane crop, parasites are harmless to human beings and control of environmental pollution are the merits of biological control of pests in sugarcane as reported by Rajendran and Balamurugan (1994).

Muthuraman (1995b) reported several advantages of application of farm yard manure as perceived by Andhra Pradesh farmers. They are : (1) simplicity of the technology, (2) low cost, (3) higher yield, (4) improved soil fertility, (5) imparts drought resistance, and (6) ensure uniform maturity of crops.

Application of pressmud cake of 11 tons per hectare in combination with nitrogen significantly increased the yield of sugarcane at Parbhani. Thus, saving the cost of phosphorus and potash fertilizer (More *et al.*, 1995).

Soybean is a leguminous crop which fixes atmospheric nitrogen in the soil. Intercropping of early maturing soybean varieties with sugarcane also increases the farmers' income from the same land area (Anonymous, 1996d).

Aggarwal (1996) revealed that application of farm yard manure as well as green manuring in maize not only saved nitrogen but also improved crop sequence productivity. Green manuring in rice saved nitrogen only, but farm yard manure saved nitrogen and also improved the yield of succeeding wheat crop.

Results of experiments in South Gujarat revealed that when rabi pulses were grown after paddy on residual moisture, it was not necessary to apply any fertilizers to pulses. Further, it was found that when legume was included in cropping sequence (greengram-paddy), it reduced the nitrogen requirement of paddy by 25 per cent (Ahlawat, 1996).

Field experiments conducted in Agricultural Research Station, Sankeswar during 1994 revealed that by applying Azospirillum (Biofertilizer) to sugarcane crop, 25 per cent of inorganic fertilizers could be saved (Angadi et al., 1996).

Sugarcane research at Sankeshwar indicated saving in the use of chemical fertilizers by application of vermicompost which provided the major nutrients to the crop (Angadi and Radder, 1996).

Durai and Ravichandran (1996) revealed that the application of seven kgs of Azospirillum (35 packets) along with 225 kg of nitrogen per hectare recorded same sugarcane

yield as that of 300 kg of nitrogen per hectare which resulted in saving of 75 kg nitrogen per hectare.

Jiji et al. (1996) found that application of vermicompost along with half or three-fourth dose of inorganic fertilizers was equally effective as the recommended manurial schedule, consisting of farm yard manure and full inorganic fertilizers in increasing yield. Further, it was indicated that in the case of cowpea, application of vermicompost instead of farm yard manure was equally effective.

Intercropping and incorporation of daincha (Sesbania aculeata) positively influenced the soil fertility and cane yield and quality in experiments conducted at Sugarcane Research Station, Sirugamani, Tamil Nadu Agricultural University (Mahendran and Kulandaivelu, 1996).

Singh and Aggarwal (1996) observed that addition of Vinasse (Distilleries discharge liquid waste) increased the cane yield of plant crop by 28.4 tonnes per hectare as compared to untreated control without vinasse.

Effective utilization of renewable sources of nutrients (organic manures and biological sources) could meet 40-50 per cent of the nutrient requirement of wheat, saving costly inorganic fertilizers, a non-renewable source of energy (Rajendra-Kumar et al., 1996).

Biocycling of organic wastes helps to improve the soil properties like bulk density, infiltration, water holding capacity, pH, etc. It also improves the soil health by improving the clay humus complex, nutrient status, buffering capacity, and yield of crops (Ramaswamy, 1996).

Field experiments conducted in Regional Research Station, Bijapur revealed that application of one tonne vermicompost per hectare can substitute 25 to 50 per cent of the recommended dose of fertilizers (Sarawad, 1996).

Shankaraiah et al. (1996a) concluded that intercropping with french bean and incorporation of the same after harvest of beans in sugarcane is highly beneficial and remunerative to the cane growers both in terms of additional income from beans and considerable increase in the yield of sugarcane crop due to residual nitrogen leftover.

Shankaraiah et al. (1996b) revealed that the economics of the use of biofertilizers in sugarcane was found to be highly remunerative with higher cost benefit ratio of 1:3.89 to 1:3.60 with *Azotobacter* and *Azospirillum*, respectively as compared to 1:3.55 with no inoculation of biofertilizers.

Sundara et al. (1996) reported that sugarcane based intercropping systems involving green manure crops, pulses, soybean, groundnut etc., can help in improving sugarcane nutrition, while rotational crops such as ragi, rice, pulses

were found to add considerable amount of organic matter to the system.

The forementioned reviews bring out a number of advantages in practicing sustainable agricultural technologies. They are : (1) bringing down environmental pollution, (2) enriching soil health and soil fertility, (3) reduces the attack of pests and diseases due to use of organic manures, (4) minimizing the use of resources like nitrogenous fertilizers, water requirement etc., thereby, reducing the cost of production, and (5) giving sustained increased yields as well as quality crops.

2.4 Personal, behavioural, motivational, situational and extension factors and adoption of agricultural technologies

2.4.1 Personal factors and adoption

Joshi (1985) found that age of the farmers was non-significantly related to adoption of sugarcane practices and productivity.

Dunlop et al. (1992) reported that older, smaller and less educated farmers were having significantly broader view of sustainability than younger, big and graduate farmers.

Jandhyala and Tilak (1993) observed that education was found to influence significantly the adoption of various agricultural practices in paddy cultivation.

Wasnik (1993) revealed that socio-economic status was significantly associated with knowledge and adoption of sugarcane practices.

Farmers' age, education and socio-economic status had a positive and significant relationship with sustainability of rice farming (Chandregowda, 1996).

Farmers' age had a positive and significant relationship with the adoption of integrated nutrient management practices in rice farming (Chandregowda and Jayaramaiah, 1996).

2.4.2 Behavioural factors and adoption

Rotti (1983) conducted a study in Belgaum district of Karnataka State and found that there was a positive and significant correlation between knowledge and adoption of recommended sugarcane cultivation practices.

A study on attitude of farmers towards soil conservation programme conducted by Sinha et al. (1984) revealed that majority of the farmers (80 per cent) had medium level of attitude and the rest were distributed under high (12 per cent) and low (8 per cent) attitude categories.

Kutty and Rao (1985) studied the relationship between knowledge and adoption of rice farming practices. The zero order correlation between knowledge and adoption was positive and significant.

Kher and Halyal (1990) revealed positive association of adoption of recommended sugarcane practices with sugarcane growers' knowledge about sugarcane production technology.

Wasnik (1993) indicated that a great majority of sugarcane growers had good knowledge about planting (69 per cent), varieties (75 per cent), seed rate (75 per cent), seed treatment (67 per cent), spacing (53 per cent), and fertilizer application (50 per cent). However, they had less knowledge about pests and diseases attack (44 per cent). Less than 48 per cent of the sugarcane growers had less knowledge about gap filling and harvesting sugarcane at ground level.

Farmers' knowledge level was found to have significant positive correlation with sustainability of the orchard plantation (Jayale and Nachane, 1995).

Knowledge about the potentialities of green manures had a positive and significant relationship with the adoption of green manures in rice based cropping system (Muthuraman, 1995b).

Favourable attitude towards sustainable farming was found to have positive and significant relationship with adoption of sustainability of rice farming (Chandregowda, 1996).

Favourable attitude towards organic farming was one of the important factors responsible for the shift from intensive agriculture to organic farming by farmers (Ramesh and Jayaramaiah, 1996).

Favourable attitude towards sustainable farming had a positive relationship with sustainability of rice and sugarcane farming (Rao, 1997).

2.4.3 Motivational factors and adoption

Reddy (1974) revealed that scientific orientation, economic motivation and risk orientation were associated with adoption behaviour and farm productivity of small farmers.

Palaniswamy (1978) and Sakthivel (1979) reported a non-significant relationship between scientific orientation and adoption behaviour of farmers. However, Singh (1982) and Ramegowda (1983) reported positive and significant relationship between scientific orientation and adoption behaviour.

Rannorey (1979) observed significant relationship between adoption behaviour and innovative proneness. However, Sinha and Kolte (1979) indicated that change proneness was not significantly related to adoption behaviour of the farmers.

Pamadi (1980) found that there was no significant association between social participation of the farmers and

their adoption of irrigated groundnut cultivation practices, while Somasundaram (1993) observed that social participation was associated with increasing knowledge and adoption level of rice farmers in Rewa district of Madhya Pradesh.

Sheshachar (1980) identified a positive relationship between value orientation of farmers and their adoption behaviour.

Rao (1983) found positive and significant correlation between farming performance and innovativeness and achievement motivation.

Sridharan (1981) indicated that scientific orientation had significant relationship with the extent of adoption.

Renukaradhya (1983) revealed that achievement orientation was positively and significantly related to adoption behaviour of farmers. However, Kumbar (1983) concluded that there was a non-significant relationship between achievement orientation and adoption behaviour of farmers.

Rameshbabu (1986) revealed that there was a highly significant association between management orientation and adoption behaviour of grape growers.

Olosson (1988) reported that Ohaji cassava farmers were highly cosmopolite with 90 per cent visiting urban areas

several times in a month and had adopted more number of practices.

Ramegowda (1991) revealed positive and significant relationship between crisis management of farms and their prior exposure to crisis and achievement motivation.

Three variables, namely, innovativeness, value orientation and achievement motivation were found to have positive and significant relationship with sustainability of rice farming (Chandregowda, 1996).

Farmers' aspiration and economic motivation had positive and significant relationship with the adoption of integrated nutrient management practices in rice farming (Chandregowda and Jayaramaiah, 1996).

Motivational factors like deferred gratification, limited aspirations and personal factors like scientific rationality, awareness of the ill effects of chemicals and a liking for coexistence with nature were some of the factors responsible for the shift from intensive agriculture to organic farming (Ramesh and Jayaramaiah, 1996).

Management orientation of redgram farmers was found to have a positive and significant relationship with the adoption of integrated pest management practices in redgram (Shivaraj, 1996).

2.4.4 Situational factors and adoption

Kumbar (1983) observed that there was a significant association between farming experiences and adoption behaviour of farmers.

Prakashkumar (1986) reported that farm size had positive and significant relationship with adoption behaviour of farmers about silkworm rearing practices.

Farm size had a significant relationship with crisis management of farms (Ramegowda, 1991).

Farmers' family size was found to have significant positive correlation with sustainability of the orchard plantation (Jayale and Nachane, 1995).

The operational holding size had a significant relationship with the adoption of organic manures in rice based cropping system (Muthuraman, 1995b).

Farm size and farming commitment had significant relationship with sustainability of rice farming (Chandregowda, 1996).

Farmers' experience in farming and farming commitment had a positive and significant relationship with the adoption of integrated nutrient management practices in rice farming (Chandregowda and Jayaramaiah, 1996).

Hanumarangaiah (1996) reported that farm mechanization was found to have a positive and significant relationship with paddy and sugarcane productivity.

Farmers' experience in sugarcane cultivation and farm power assets had positive and significant relationship with the adoption of sugarcane technologies (Karthikeyan et al., 1996).

2.4.5 Extension factors and adoption

Jha and Shakthawat (1972) reported that there was significant association between contact with extension agency and adoption of agricultural practices by farmers. Similar results were obtained by Palvannan (1985).

Srinath (1982) revealed that mass media participation was significantly associated with the adoption of agricultural practices in grape cultivation. Similar findings were reported by Prakashkumar (1986).

Rotti (1983) found that sugarcane growers consulted ten sources of information, out of which, Agricultural Assistants were the top most source consulted, followed by progressive farmers. Next sources consulted in the sequential order were friends and relatives, neighbouring farmers, radio, Cane Inspector, Assistant Agricultural Officer, opinion leaders and newspaper.

Himanthraju (1984) revealed that training of contact farmers about summer paddy cultivation resulted in the higher adoption of improved practices of paddy.

Mahadevaiah (1987) revealed that sugarcane growers had consulted ten sources of information, out of which, Agricultural Assistants were the top most source consulted followed by Sugarfactory Field Assistants. Next sources consulted in the sequential order were Cane Supervisor, friends and relatives, radio, neighbours, progressive farmers, extension literature, newspaper and input dealers.

Kher (1989) observed that extension participation of sugarcane growers was found to be significantly associated with their knowledge and adoption of sugarcane production practices.

Extension system link and research system link of farmers had positive and significant relationship with sustainability of rice farming (Chandregowda, 1996).

Contact of farmers with extension personnel was found to have positive and significant relationship with the adoption of sugarcane technologies (Karthikeyan et al., 1996).

Extension participation and extension contact of redgram farmers had positive and significant relationship

with the adoption of integrated pest management practices in redgram (Shivraj, 1996).

It is evident from the reviews cited above that personal, behavioural, motivational, situational and extension factors possess either positive or negative influence on the adoption of farming practices.

2.5 Problems faced in the adoption of sustainable agricultural technologies

Channegowda (1971) observed the following as problems expressed by farmers in increasing the yield of paddy in order of their relative importance : (1) assured irrigation water at critical periods of crop growth (52.7 per cent), (2) lack of credit facilities (19.3 per cent) and (3) poor soils (16 per cent).

Jha and Shakthawat (1972) found that a majority of bajra growers could not take up hybrid bajra cultivation due to inadequate irrigation facility, shortage of money, costly inputs and non-availability of seeds in time.

Reddy and Reddy (1972) in their study on adoption of improved practices of paddy and jowar revealed that, lack of knowledge on these practices, high cost of inputs, non-availability of materials in time, lack of technical help, more labour requirement and complexity of practices were the reasons for non-adoption.

Gaur and Jain (1984) found that factors like poor economic conditions, inadequate infrastructure facilities to purchase critical inputs in time and lack of technical guidance were found to be major factors in the non-adoption of improved practices in paddy.

Rameshbabu (1986), revealed the following factors as the main constraints in getting lower yields in grapes by farmers. They are : (1) more diseases and pests, (2) lack of irrigation facilities, (3) lack of knowledge, (4) problems of weeds, (5) micronutrients deficiency in soil, and (6) soil salinity and alkalinity.

Yadav and Gangawar (1986) in their study on rice production and constraints in Bihar found that the lack of awareness among farmers about the new technologies was the main constraint which had contributed to the low yield.

Singh and Rajendra (1990) reported that the major difficulty in the adoption of recommended practices by sugarcane farmers were non-availability of seeds (setts), followed by lack of knowledge, proper guidance, lack of irrigation facilities, lack of money and non-availability of fertilizers in time.

Non-availability of seeds and farm yard manure and lack of technical knowledge were the constraints faced by majority of paddy growing farmers in paddy production (Srivastava and Singh, 1990).

Shivaram (1991) conclude that before one takes up natural farming, one should analyse the pros and cons of it.

Gopikrishna (1993) revealed that the major reasons for non-adoption of selected cultivation practices were : (1) non-availability of seeds, (2) lack of knowledge, (3) inadequate quantity of farm yard manure, (4) lack of technical guidance, and (5) lack of confidence.

Anonymous (1995) indicated that persons who want to practice sustainable agriculture need to know how to prevent soil erosion, overuse of chemicals, water logging, salination and overexploitation of ground water.

The low level of sustainability of paddy farming is due to poor management of nutrients and water in irrigated rice ecosystem (Chandregowda, 1996).

Non-use and/or inadequate application of organic manure (farm yard manure/compost, biofertilizers and crop residue), non-application of soil amendments and micronutrients, and imbalanced and/or excess application of inorganic fertilizers were some of the improper nutrient management practices followed by rice growers (Chandregowda and Jayaramaiah, 1996).

The major constraints faced by farmers of Tamil Nadu State in the adoption of integrated pest management practices

in cotton were lack of adequate knowledge on the natural predators and parasites (50.83 per cent) and lack of adequate knowledge on the economic threshold level of pests (47.5 per cent) as reported by Iqbal et al. (1996).

Non-availability of pheromone traps/predator/nuclear polyhydrous virus, lack of knowledge in the selection of integrated pest management practices and lack of technical guidance were the major constraints which came in the way of adoption of integrated pest management practices in redgram (Shivaraj, 1996).

The studies on problems/constraints in the adoption of recommended sustainable technologies indicate lack of knowledge, high cost of inputs, non-availability of inputs intime, lack of technical guidance, and low price for their farm produce.

HYPOTHESES OF THE STUDY

Keeping in view the objectives of the study and review of literature, the following hypotheses were developed for testing.

- H₁ : Sustainability of sugarcane farming is a composite of several components.
- H₂ : The personal, behavioural, motivational, situational and extension factors (independent variables) of sugarcane farmers do not have significant relationship with the adoption levels of sustainable sugarcane farming practices.

- H₃ : The personal, behavioural, motivational, situational and extension factors (independent variables) of sugarcane farmers do not contribute for the adoption levels of sustainable sugarcane farming practices.
- H₄ : The personal, behavioural, motivational, situational and extension factors (independent variables) do not discriminate high and low adoption levels of sustainable sugarcane farming practices.

MATERIAL AND METHODS

CHAPTER III

MATERIAL AND METHODS

The material and methods used in conducting the study has been presented under the following headings :

- 3.1 Locale of the study
- 3.2 Research design
- 3.3 Research variables
- 3.4 Operationalisation and measurement of sustainability of sugarcane farming
- 3.5 Measurement of independent variables
- 3.6 Development of interview schedule
- 3.7 Collection of data
- 3.8 Analysis of data

3.1 Locale of the study

3.1.1 Selection of district

The study was conducted in Mandya district of Karnataka State during June 1997. Mandya district was purposively selected, since it is considered to be one of the agriculturally progressive districts in Karnataka. Moreover, much as 40 per cent of the agricultural land is under irrigation. The river Cauvery and its tributaries namely, Hemavati, Dakshyani and Lokapavani are the main sources of canal irrigation. Consequently, these irrigation facilities

have rendered farmers to grow predominantly sugarcane as an important cash crop.

3.1.2 Selection of taluk

Out of seven taluks of the Mandya district, Srirangapatna taluk was purposively selected for the study (Fig. 1), since this taluk has recorded highest productivity of sugarcane (127.5 tonnes per hectare) from the last three years.

3.1.3 Selection of villages

Sugarcane is grown in 32605 hectares in Mandya district (Anonymous, 1996e). Srirangapatna taluk occupies (11.98 per cent (3908 hectares) of the total acreage under sugarcane in the district. In all the 95 villages of Srirangapatna taluk, sugarcane is grown as a cash crop.

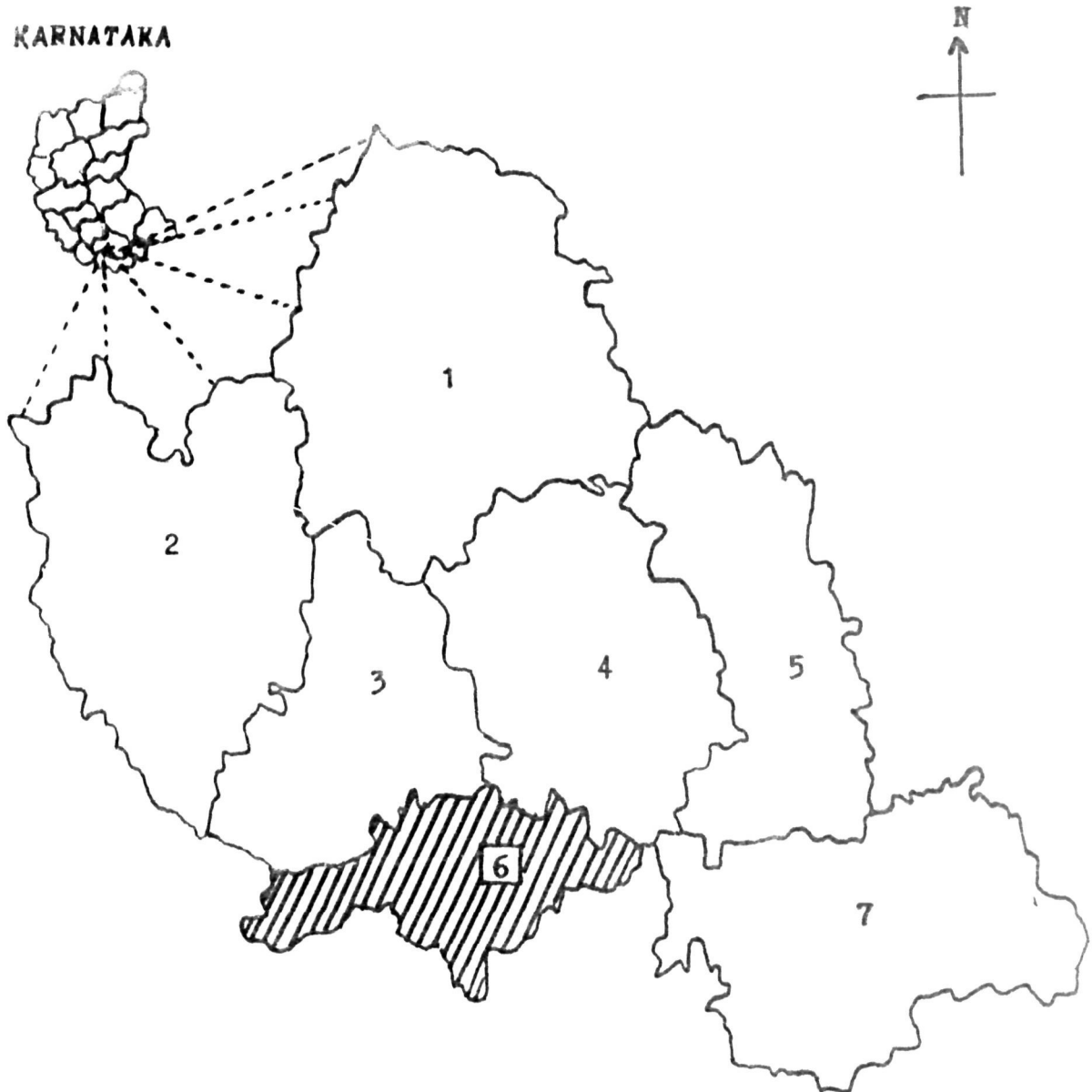
Ten villages were randomly selected for the study out of 95 villages in Srirangapatna taluk. The selected villages are Anandur, Baburayanakoppal, Belagola, Darasaguppe, Ganjam, Hosahalli, Karekura, Kirangur, K.Shettahalli and Srirangapatna.

3.1.4 Selection of respondents

Two criteria were followed in the selection of respondents. They are :

MAP OF MANDYA DISTRICT

KARNATAKA



TALUKS OF MANDYA DISTRICT

1. NAGAMANGALA	5. MALDUR
2. KRISNARAJPET	6. SRIRANGAPATNA
3. PANDAVAPURA	7. MALAVALLI
4. MANDYA	

 Taluk Selected for the Study

Figure 1: LOCALE OF THE STUDY

1. A farmer should have practiced ratoon in sugarcane (Ratoon management in sugarcane is identified as one of the components of sustainability in sugarcane farming), and

2. A farmer should have successfully harvested at least three crops of sugarcane (land productivity is one of the independent variables selected for the study, where average of three years yield of sugarcane is considered to compute land productivity).

From each of the selected ten villages, twenty sugarcane farmers who fulfilled the above two criteria were selected using purposive random sampling method. Thus, the total number of respondents for the study comprised 200. Details are given under:

Table A. Number of respondents selected for the study based on two criteria.

Sl. No.	Villages	Total number of sugarcane farmers in the village	Total number of sugarcane farmers who satisfied the two criteria	Number of sugarcane farmers selected for the study
1.	Anandur	182	95	20
2.	Baburayanakoppal	392	192	20
3.	Belagola	434	222	20
4.	Darasaguppe	326	186	20
5.	Ganjam	211	97	20
6.	Hosahalli	181	91	20
7.	Karekura	82	42	20
8.	Kirangur	126	69	20
9.	K.Shetahalli	369	181	20
10.	Srirangapatna	192	98	20
Total		2495	1273	200

3.2 Research design

Expost-facto research design was adopted for conducting the study.

3.3 Research variables

The sustainability of sugarcane farming was considered as dependent variable in the present investigation. Thirty independent variables were selected and classified under personal, behavioural, motivational, situational and extension factors. These 30 independent variables were studied to know their relationship and influence on the dependent variable (sustainability of sugarcane farming). The classification of independent variables was done based on the researchers' perception as well as review of the past works.

The list of variables and measurement tools are presented below :

<u>Variable</u>	<u>Measurement tool</u>
<u>Dependent variable</u>	
Sustainability of sugarcane farming	Sustainable Technology Adoption Index developed for the study

Components of sustainability of sugarcane farming

Land preparation	Index developed for the study
Seeds (setts) and sowing	Index developed for the study
Sugarcane based cropping system	Index developed for the study
Integrated nutrient management	Index developed for the study
Water management	Index developed for the study
Integrated pest management	Index developed for the study
Ratoon management	Index developed for the study
Maturity and Harvesting	Index developed for the study

Independent variables

Personal Factors

Age	Schedule developed for the study
Education	Scale of Trivedi (1963)
Socio-economic status	Scale of Venkataramaiah (1983)

Behavioural Factors

Knowledge about sustainable sugarcane farming technologies	Scale developed for the study
Attitude towards sustainable farming	Scale of Beus and Dunlop (1991), and modified by Chandregowda (1996) is adopted

Motivational Factors

Management orientation	Scale developed by Samanta(1977)
Risk orientation	Scale developed by Nagaraja (1989)

Scientific orientation	Scale developed by Supe (1969) and modified by Nagaraja (1989) is adopted
Economic motivation	Scale of Supe (1969)
Value orientation	Scale of Alexander (1982)
Achievement orientation	Scale of Singh (1978)
Level of aspiration	Scale of Cantrill (1965)
Innovativeness	Scale developed by Feaster (1968) and modified by Prasad (1983) is adopted
Deferred gratification	Scale developed by Sen (1969)
Cosmopoliteness	Scale of Desai (1975)
Social participation	Schedule developed for the study

Situational Factors

Family size	Schedule developed for the study
Farm size	Schedule developed for the study
Sugarcane farming experience	Schedule developed for the study
Herd size	Scale of Yogananda (1992)
Self-reliance	Scale of Prasad (1983)
Input self-sufficiency	Index developed by Chandregowda (1996)
Farm mechanization	Scale of Trivedi (1963)
Farming commitment	Scale of Ramegowda (1991)
Land productivity	Formula developed by Chandregowda (1996)

Extension Factors

Mass media use	Schedule developed for the study
Participation in Training programme	Schedule developed by Nagaraja (1989)

Farm scientist contact	Schedule developed for the study
Extension agency contact	Schedule developed for the study
Extension participation	Schedule developed by Rattaiah (1979)

A schematic representation of the factors (independent variables) of sustainability of sugarcane farming is shown in Fig. 2.

3.4 Operationalisation and measurement of sustainability of sugarcane farming (Dependent variable)

3.4.1 Operationalisation of sustainability of sugarcane farming

Sustainability of sugarcane farming is operationalised as the extent to which farmer manages soil and water resources relying mainly on onfarm resources (i.e., the use of locally available resources, non cash and low cost inputs and minimizing the use of chemicals) to maintain or enhance the productivity without affecting the production environment.

3.4.2 Measurement of sustainability of sugarcane farming

The sustainability of sugarcane farming is measured by using Sustainable Technology Adoption Index. The procedure for developing this index is as follows :

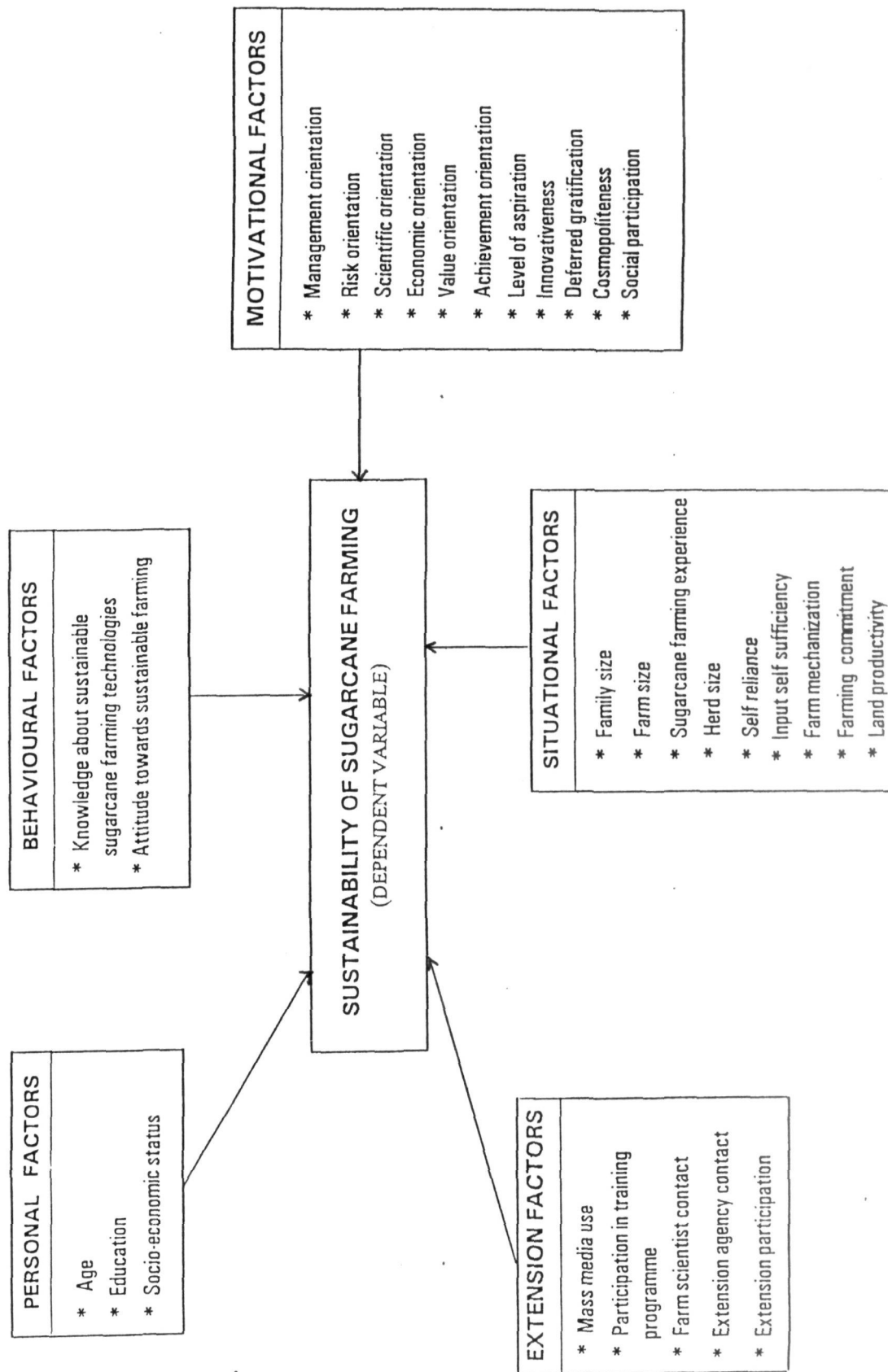


FIGURE 2 : SCHEMATIC REPRESENTATION OF THE FACTORS OF SUSTAINABILITY OF SUGARCANE FARMING

3.4.2.1 Selection of components and technologies of sustainable sugarcane farming

3.4.2.1.1 Item pooling

Based on review of literature and in consultation with the Sugarcane Specialists of the University of Agricultural Sciences, Bangalore, Senior Agricultural Officers of Karnataka State Department of Agriculture and Progressive farmers. The following eight components of sustainable sugarcane farming were identified. They are : (1) Land preparation, (2) Seeds (setts) and sowing, (3) Sugarcane based cropping system, (4) Intergrated nutrient management, (5) Water management, (6) Intergrated pest management, (7) Ratoon management, and (8) Maturity and Harvesting. In these eight components, 60 sustainable technologies were identified and were referred to judges to rate them on a three point continuum, namely, 'highly relevant', 'relevant' and 'not relevant' to find out its relevance to sustainable sugarcane farming (Appendix Ia).

Sl.

No.	Statement of relevancy	Score
1.	Highly relevant	2
2.	Relevant	1
3.	Not relevant	0

The judges included for the study were :

1. Sugarcane Specialists of the University of Agricultural Sciences, Bangalore and Dharwad.
2. Sugarcane Scientists working in various Sugarcane Research Institutes in different parts of the country.
3. Agricultural Officers and other Senior Officers of Karnataka State Department of Agriculture.
4. Cane Superintendents and Cane Development Officers of Sugar factories.

The items were sent to 154 judges to find out relevant sustainable sugarcane technologies. Ninety four judges returned the questionnaires duly filled.

3.4.2.1.2 Item analysis and selection

The co-efficient of variation and item analysis (correlation method) were employed to find out the relevant and important sustainable technologies in sugarcane farming. Out of 60 technologies identified, 55 were found to be relevant and important (significant) sustainable technologies in sugarcane farming as perceived by the judges based on the following criteria (Appendix Ia).

1. If the co-efficient of variation value of a particular technology is 30 or less, then that technology is found to be relevant and important one.
2. If the 'r' values of item analysis (correlation method) of a particular technology's value is more than 0.201 ('t' value at five per cent level of probability), then that technology is found to be relevant and important (significant).

Table B. Number of sustainable technologies found to be relevant under each component after computing co-efficient of variation and item analysis.

Sl. No.	Components	Number of sustainable technologies	
		Sent to judges to find out its relevancy	Found to be relevant
1.	Land preparation	2	2
2.	Seeds (setts) and sowing	7	6
3.	Sugarcane based cropping system	2	2
4.	Integrated nutrient management	17	16
5.	Water management	5	5
6.	Integrated pest management	13	11
7.	Ratoon management	11	10
8.	Maturity and Harvesting	3	3
Total		60	55

Scoring pattern followed for the adoption of 55 sustainable technologies (classified under eight components) is presented in Appendix Ib. The minimum and maximum scores one can get by adopting sustainable technologies under eight components are presented in Table C.

Table C. Minimum and maximum scores under eight components, one can get by adopting the sustainable technologies in sugarcane farming.

Sl. No.	Components	Minimum score	Maximum score
1.	Land preparation	1	3
2.	Seeds (setts) and sowing	1	6
3.	Sugarcane based cropping system	0	3
4.	Integrated nutrient management	0	46
5.	Water management	1	10
6.	Integrated pest management	0	18
7.	Ratoon management	1	13
8.	Maturity and Harvesting	0	3
Total		4	102

3.4.2.2 Measuring sustainability of sugarcane farming and its components

All the eight components of sustainable technologies in sugarcane farming namely, Land preparation, Seeds (setts and sowing), Sugarcane based cropping system, Integrated nutrient management, Water management, Integrated pest management, Ratoon management, and Maturity and Harvesting were measured using the Sustainable Technology Adoption Index. The formula is as follows :

$$\text{Sustainable Technology Adoption Index} = \frac{\text{Actual score obtained for adopting the sustainable technologies by the respondent}}{\text{Total possible score for sustainable technologies}} \times 100$$

Based on the above indicated formula the percentage adoption index is calculated for each respondent to know the extent of adoption of sustainable technologies in sugarcane farming for each component. Same formula was used to know the overall adoption of sustainable technologies in sugarcane farming by the respondents.

3.4.2.3 Operationalization of the components of the sustainable technologies in sugarcane farming

3.4.2.3.1 Land preparation

It refers to ploughing the land and preparing the land to plant canes in ridges and furrow. This component had two technologies. The maximum and minimum scores ranged from 3 and 1, respectively. Based on the mean score (2.53) obtained by the respondent, they were classified into two groups, namely, low and high.

<u>Category</u>	<u>Score</u>
Low (Mean and below)	2.53 and below
High (Above mean)	Above 2.53

3.4.2.3.2 Seeds (setts) and sowing

This includes the use of non cash and low cost technologies in the selection of good quality seeds (setts) and following recommended spacing. This component had six technologies. The maximum and minimum scores one can get is

6 and 1, respectively. Based on the mean (5.99) and standard deviation (1.00), the respondents were categorized into low, medium and high.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 5.49
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	5.49 to 6.49
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 6.49

3.4.2.3.3 Sugarcane based cropping system

This refers to practicing crop rotation and inter-cropping by farmers in sugarcane fields. This component had three technologies. The maximum and minimum scores ranged from 3 and 0, respectively. Based on the mean (1.08) and standard deviation (0.98), the respondents were categorized into three groups.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 0.59
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	0.59 to 1.57
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 1.57

3.4.2.3.4 Integrated nutrient management

It refers to the extent of application of right quantity of organic and inorganic fertilizers and amendments to soil at a proper time, method and combination aimed at

deriving maximum benefits and causing minimum damage to the resource base. This component had 16 technologies. The maximum and minimum scores a respondent can get is 46 and 0, respectively. Based on the mean (24.00) and standard deviation (7.74), the respondents were grouped into three categories namely, low, medium and high.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 20.13
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	20.13 to 27.87
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 27.87

3.4.2.3.5 Water management

It is the extent of application of practices to obtain added benefits from rainfall and water flow through irrigation to store water in soil for crop production with a proper drainage to keep the soil health intact. This component had five technologies. The maximum and minimum scores a respondent one can get is 10 and 1, respectively. The respondents were classified into three categories namely, low, medium and high based on the mean (6.66) and standard deviation (1.02).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 6.15
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	6.15 to 7.17
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 7.17

3.4.2.3.6 Integrated pest management

It refers to management of pests (insects, diseases and weeds) by using preventive and curative measures through judicious combination of cultural, mechanical, biological and chemical means. This component had 11 technologies. The maximum and minimum scores one can get is 18 and 0, respectively. Based on the mean (11.90) and standard deviation (3.18), the respondents were classified into three categories.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 10.31
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	10.31 to 13.49
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 13.49

3.4.2.3.7 Ratoon management

It refers to subsequent harvesting taken from the cane stubble after first harvest. Cultivation practices for ratoon crop includes all the practices as that of main crop except land preparation and planting setts. This component had 10 technologies. The maximum and minimum scores a respondent can get is 13 and 1, respectively. The respondents were classified into three categories based on the mean (8.35) and standard deviation (2.04) as a measure of check.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 7.33
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	7.33 to 9.37
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 9.37

3.4.2.3.8 Maturity and harvesting

It includes methods of judging maturity of the crop, adopting right time and correct method of harvesting the crop to obtain sustainable yield. This component had three technologies. The maximum and minimum scores one can get is 3 and 0, respectively. Based on the mean (2.12) and standard deviation (0.72), the respondents were classified into three groups.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 1.76
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	1.76 to 2.48
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 2.48

3.4.2.4 Overall adoption of sustainable technologies in sugarcane farming

This refers to the adoption of sustainable technologies in all the eight components. The Sustainable Technology Adoption Index is followed to know the adoption pattern of sustainable technologies in sugarcane farming. The maximum and minimum score one can get is 102 and 4, respectively.

3.4.2.4.1 Reliability and validity of Sustainable Sugarcane Farming Practices

An instrument or an index has to be reliable and valid to prove its usefulness as well as its accuracy. This is more so when a composite index is obtained by combining several components.

3.4.2.4.1.1 Reliability

Reliability refers to the precision of the instrument which reveals the extent to which repeated measurements gives the same results. Split half method (Henry et al., 1973) was used to establish the reliability of the instrument. For this purpose the instrument was administered to 30 farmers growing sugarcane on a random basis in a non-sample area. The reliability coefficient was found to be 0.77 which was significant at one per cent level. Hence, the test was found to be reliable.

3.4.2.4.1.2 Validity

Validity refers to whether the instrument measures the same variable/aspect which it is suppose to measure. The content validity of the instrument was established as follows:

As a first step, a survey of the literature on sustainable sugarcane farming technologies/practices were made. Keeping this as a basis, Sugarcane Specialists in the

University of Agricultural Sciences, Bangalore, several Senior Agricultural Officers serving in Karnataka State Department of Agriculture and Progressive farmers were consulted to identify the various components of sustainable sugarcane farming.

As a second step, a number of items referring to different technologies/practices were formed for each component.

As a third step, these components along with their items (sub-components) were given to a number of judges to get their opinion as to their relevance or otherwise. The judges included for the purpose were Sugarcane Specialists working in Agricultural Universities, Research Institutions, State Department of Agriculture and those working in Sugar factories.

Lastly, those items which were found to have a coefficient of variation of 30 or less and which have a correlation value of 0.20 or more with the total score, were included in the final instrument.

Thus, the content validity of the instrument to measure sustainability of sugarcane farming was established.

Based on the total score of the respondents in the overall adoption of sustainable technologies in sugarcane

farming, the respondents were classified into three categories namely, low, medium and high based on the mean (62.80) and standard deviation (14.90).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 55.34
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	55.34 to 70.25
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 70.25

3.5 Measurement of Independent Variables

3.5.1 Personal Factors

3.5.1.1 Age : The number of years completed by the respondent since birth is taken as the actual age.

The respondents were classified as young, middle and old aged based on the age in years recorded using the statistical device mean $\pm \frac{1}{2}$ standard deviation ($\bar{X} = 47.20$, SD = 13.27).

<u>Category</u>	<u>Age (years)</u>
Young (Below $\bar{X} - \frac{1}{2}$ SD)	Below 40.56
Middle ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	40.56 to 53.83
Old (Above $\bar{X} + \frac{1}{2}$ SD)	Above 53.83

3.5.1.2 Education : It refers to the formal educational level of the respondents. This was quantified by using the

items and weights used by Trivedi (1963). The different levels of education and their weights are as follows :

<u>Educational level</u>	<u>Weights</u>
Illiterate	0
Literate	1
Primary	2
Middle	3
S.S.L.C.	4
P.U.C.	5
Graduate/Diploma	6

The respondents were classified into three categories on the basis of the mean (3.33) and standard deviation (1.86) as a measure of check.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 2.40
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	2.40 to 4.26
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 4.26

3.5.1.3 Socio-economic status : It is defined as the position of an individual in a family occupied with reference to the prevailing average standards of cultural possessions, effective income, material possessions and participation in the community (Chapin, 1928).

The socio-economic status in the present study was measured with the help of a scale developed by Venkataramaiah (1983). The scale has five subcomponents viz., occupation, land holding, annual income, house and material possession. Details of items included and weights used for quantifying socio-economic status were as follows :

<u>Items</u>	<u>Weights</u>
(a) <u>Occupation</u>	
None	0
Unskilled	1
Semi-skilled	2
Skilled	3
Farming/Business	4
Professional	5
(b) <u>Land holding</u>	
Small	1
Large	2
(c) <u>Annual income</u>	
Less than 20,000	1
20,001 to 40,000	2
40,001 to 60,000	3
60,001 to 80,000	4
80,001 to 1,00,000	5
More than 1,00,000	6

(d) House

Thatched	1
Mud walled thatched	2
Brick wall tiled	3
Concrete house	4
Concrete double storied	5

(c) Material possession

None	0
One farm animal/bullock/ buffalo/cycle/furniture	1
Two farm animals/bullock cart	2
Three to four farm animals/ improved farm implement/ newspaper/electricity	3
5 to 10 farm animals/ gobergas/pumpset/bike	4
More than 10 farm animals/ tractor/automobiles	5

The scores of all the above factors were summed up to assess the socio-economic status of the respondents. The total scores of the respondents ranged from 0 to 23.

Further, socio-economic status was classified into three categories on the mean (13.03) and standard deviation (1.89) as a measure of check.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 12.05
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	12.05 to 13.94
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 13.94

3.5.2 Behavioural Factors

3.5.2.1 Knowledge about sustainable sugarcane farming technologies : Knowledge includes all those behaviour and test situations which emphasise the remembering either by recognition or by recall of items and materials on some phenomenon with regard to sustainable sugarcane farming technologies. This concept was operationalized by developing a set of items which constituted the knowledge test.

Twenty one items on eight components of sustainable sugarcane farming technologies were included in the knowledge test in consultation with Sugarcane Specialists from University of Agricultural Sciences, Bangalore. The maximum and minimum scores one can get is 21 and 0, respectively. Based on the mean (13.45) and standard deviation (3.70), the respondents were classified into three categories.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 11.60
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	11.60 to 15.30
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 15.30

3.5.2.2 Attitude towards sustainable farming : Attitude is a relatively enduring organization of an individual's belief about an object that predisposes his actions (Rogers and Shoemaker, 1971).

Rokeach (1986) further indicates that attitudes are subsystems of beliefs and values organized around an object or situation. The entire set of attitudes that a person holds constitute a belief system - the total universe of beliefs that a person has about the physical world, the social world and the self.

The present study has made use of the scale developed by Beus and Dunlop (1991) aimed at measuring the basic beliefs and values toward scientific versus traditional agriculture. The authors have used this scale again to study the relationship between attitude towards alternative or sustainable agriculture and the practice of agriculture (Beus and Dunlop, 1994).

The original scale had 24 statements with two contrasting views placed on either side of the five point continuum ranging from 'strongly agree' to the left hand side to the 'strongly disagree' on the right hand side. The scale was restandardised to make it adaptable to Indian situations by Chandregowda (1996) as follows :

The final scale consisted of 18 statements of which ten statements are positive and another ten statements are negative. These have been randomly listed in the final format. The responses were obtained on a five point continuum of agreement ranging from 'strongly agree' to 'strongly disagree'. A score of 5, 4, 3, 2 and 1 for positive statements and the reverse for negative statements was given for the respective responses on the continuum. In this way, minimum and maximum possible scores one can get is 18 and 90, respectively. Further, the respondents were divided into three categories based on the mean (51.52) and standard deviation (12.83).

<u>Category</u>	<u>Score</u>
Favourable (Below $\bar{X} - \frac{1}{2}$ SD)	Below 45.10
Neutral ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	45.10 to 57.93
Unfavourable (Above $\bar{X} + \frac{1}{2}$ SD)	Above 57.93

3.5.3 Motivational Factors

3.5.3.1 Management orientation : In the present study, the management orientation has been operationally defined as the degree to which a farmer is oriented towards scientific farm management comprising of planning, production and marketing functions of the farm. This variable was measured by adopting the scale developed by Samanta (1977). The scale consists of totally 18 statements, six statements for each of

planning, production and marketing aspects. The management orientation scale has got two responses for each statement as agree and disagree. The orientation of scoring was conceptually unidirectional. The positive statements were given a score of one for agree and zero for disagree. The scoring was reversed in the case of negative statements. The range of scores for the scale is from 0 to 18.

The groupings for the total obtained scores of the farmers were classified as low, medium and high responses using the mean (11.16) and standard deviation (2.90).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 9.71
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	9.71 to 12.61
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 12.61

3.5.3.2 Risk orientation : It is the degree to which a farmer is oriented towards risk and uncertainty in agriculture management and has the courage to face the various risks involved in agricultural aspects.

Nagaraja (1989) developed a scale for measuring risk orientation of farmers. The scale contained six statements. The same scale was used in the present study with some modifications. Only five statements relevant to the present study were included. Fourth statement was negatively keyed

and all others were positively keyed. In the case of positive statements, a score of one was assigned for the positive response (agree) and zero score for negative (disagree) response. This was reversed in the case of negative statement. The scores were added to get total score of the respondent. The maximum and minimum scores one can get is 5 and 0, respectively. The respondents were grouped into three categories based on their total risk orientation score using the mean (2.33) and standard deviation (1.46).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 1.60
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	1.60 to 3.06
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 3.06

3.5.3.3 Scientific orientation : It is defined as the degree to which a farmer is oriented to the use of scientific methods in agriculture.

The variable was quantified by using the scientific orientation scale of Supe (1969), with slight modifications made by Nagaraja (1989). The scale has six statements with three response categories as 'Agree', 'Undecided' and 'Disagree'. For five statements (except statement No. 2), a score of two was assigned to 'Agree' response, a score of one for 'Undecided' and zero score for 'Disagree' response. The scoring procedure was reversed in the case of second statement.

The summation of the score obtained by a farmer for all the six statements indicates his scientific orientation. The total score ranged from 0 to 12. The level of scientific orientation was categorized as indicated below using the mean (6.48) and standard deviation (2.34).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2} SD$)	Below 5.31
Medium ($\bar{X} - \frac{1}{2} SD$ to $\bar{X} + \frac{1}{2} SD$)	5.31 to 7.65
High (Above $\bar{X} + \frac{1}{2} SD$)	Above 7.65

3.5.3.4 **Economic motivation** : It is defined as the extent to which an individual is oriented towards achievement of the maximum economic ends such as maximization of profits.

Economic motivation scale developed by Supe (1969) was followed. The responses were obtained on 'Yes' and 'No' dichotomous categories for each statement. The first three statements in the scale were positive and the last three were negative. 'Yes' response on a positive statement and 'No' response on a negative statement attracted one score each. Thus, the minimum and maximum possible scores were 0 and 6, respectively. Based on the mean (3.00) and standard deviation (1.59), the respondent farmers were classified into three categories.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 2.20
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	2.20 to 3.79
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 3.79

3.5.3.5 Value orientation : Values are the standards upon which evaluations are made, the criteria by which both ends and means are chosen. Consequently, an individual is emotionally committed to standards in such a way that they influence, guide and direct his behaviour.

The scale developed by Alexander (1982) was utilized in this study to measure value orientation of the respondent farmers. The ten statements were measured on a dichotomous response category viz., 'agree' and 'disagree'. The value oriented statements received score of 1 and 0, respectively whereas, the other statements received 0 and 1, respectively. Thus, the minimum and maximum possible scores were 0 and 10, respectively. Later on respondents were classified into three categories to indicate the different levels of value orientation based on the mean (5.22) and standard deviation (2.29).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 4.07
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	4.07 to 6.36
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 6.36

3.5.3.6 **Achievement orientation :** It is the desire to do well not so much for the sake of social recognition or prestige, but to realize the feeling of personal accomplishment. In the present study, the achievement orientation is defined as the value associated with an individual which drives him to excel in farming and related fields and thereby attain a sense of personal accomplishment.

The achievement orientation scale developed by Singh (1978) was used in the present study. The scale has six statements in the form of questions. Each question has five alternative responses. The respondent has to tick one of the alternatives to each statement.

The statements 1, 4 and 6 are positive statements with scoring weights of 5, 4, 3, 2 and 1. The scoring was reversed for the other selected negative statements. The summed up values give the total score of an individual farmer. Thus, the total score ranged from 0 to 30.

To assess the level of achievement, the respondents were categorized as low, medium and high based on the mean (16.10) and standard deviation (5.27).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 13.40
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	13.40 to 18.73
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 18.73

3.5.3.7 Level of aspiration: It is defined as the possible goal an individual sets himself in his performance.

Self-anchoring striving scale developed by Cantrill (1965) was adopted in this study to measure the level of aspiration. A figure of ten step ladder was shown to the respondents and were asked to answer three questions regarding their status five years back, today and five years from now, considering the top (10th) step on the ladder as the best possible life and first step as the worst possible life. The summation of the ladder step numbers indicated by the respondent farmer for the three questions was taken as the level of aspiration score. Theoretically, minimum possible score was 3 and the maximum possible score was 30 in this scale. The respondents were classified into three categories based on the mean (15.88) and standard deviation (5.11).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 13.32
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	13.32 to 18.43
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 18.43

3.5.3.8 Innovativeness: Innovativeness is operationalised as socio-psychological orientation of an individual to get linked or closely associated with change, adopting innovative ideas and scientific practices.

The innovativeness scale developed by Feaster (1968) and as modified by Prasad (1983) was used in this study. Eight statements with first four positive and next four negative constituted the scale. The responses were obtained on a three point continuum viz., 'Yes', 'Undecided' and 'No' with a scoring pattern of 2, 1 and 0, respectively, for positive statements and 0, 1 and 2 for negative statements. The summated score indicated the innovativeness of the farmer. The maximum possible score was 16 and minimum possible was 0. Based on the mean (8.78) and standard deviation (3.59), the respondents were classified into three major categories.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 6.98
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	6.98 to 10.57
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 10.57

3.5.3.9 Deferred gratification : Rogers and Svenning (1967) defined deferred gratification as the postponement of immediate satisfaction of need in anticipation of future rewards. The scoring procedure developed by Sen (1969) was followed in this investigation and the same is indicated as follows :

How would you like to spend your income from farming this year?

Responses	Score
Family expenses or consumption on food, clothes, furniture, repairs or addition to home, etc.	1
Social obligation, wedding, birth right, feast, etc.	2
Pay off debts	3
Save	4
Purchase or save to purchase land	5
Purchase or save money to purchase agricultural inputs	6
Invest or save money to invest in non-agricultural business	7
Education	8

The maximum and minimum scores one can get is 7 and 0, respectively. Based on the mean (4.61) and standard deviation (2.23), the respondents were categorised into three categories.

<u>Category</u>	<u>Score</u>
	Below 3.49
Low (Below $X - 2 \text{ SD}$ to $X + \frac{1}{2} \text{ SD}$)	3.49 to 5.72
High (Above $X + \frac{1}{2} \text{ SD}$)	Above 5.72

3.5.3.10 **Cosmopoliteness** : It is defined as the degree to which an individual is oriented to his immediate social

system outside. The cosmopolitaness of a farmer is likely to be unique in an individual and is motivated to look beyond his environment, when most others are content to maintain a localistic frame of reference.

This variable was measured using the scale developed by Desai (1975). The dimensions of the variable considered in this case are :

- (a) The frequency of visits to the nearest town
- (b) The purpose of visits to the town

The items and their scoring followed in quantifying the frequency of visits were as follows :

<u>Item</u>	<u>Score</u>
(a) Two or more per week	5
(b) Once per week	4
(c) Once in fifteen days	3
(d) Once in a month	2
(e) Seldom	1
(f) Never	0

The item and scoring procedure to quantify the purpose of the visit were as follows :

<u>Item</u>	<u>Score</u>
(a) All visits relating to agriculture	3
(b) Some relating to agriculture	2
(c) Others	1

The cumulative score for the items obtainable is 15 and 0 as maximum and minimum, respectively. Based on the mean (7.09) and standard deviation (3.50), the respondents were classified as under :

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 5.34
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	5.34 to 8.84
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 8.84

3.5.3.11 Social participation : It was measured by the respondents level of involvement in local formal and informal organizations and their interaction with friends, relatives and neighbours for the purpose of obtaining information and assistance, particularly, during the last one year. The involvement of farmers in informal groups is not accounted for due to the difficulty in getting the desired information. The scoring procedure followed is as follows :

Sl. No.	Organization	Position		Participation in meetings		
		Mem- bers	Office bearer	Never	Occasio- naly	Regu- larly
1.	Zilla Parishat	1	2	0	1	2
2.	Mandal Panchayat	1	2	0	1	2
3.	Land Development Bank	1	2	0	1	2
4.	Youth clubs	1	2	0	1	2
5.	Service Co-opera- tive Society	1	2	0	1	2
6.	Raitha Sangha (Far- mers Organisation)	1	2	0	1	2
7.	Others	1	2	0	1	2

The scores of the respondents ranged from 0 to 15. Based on the mean (8.55) and standard deviation (3.47), the respondents were classified into low, medium and high level of social participation.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 6.81
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	6.81 to 10.28
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 10.28

3.5.4 Situational Factors

3.5.4.1 Family size : It refers to the total number of persons in a family. However, children below 12 years and

persons above 70 years of age were not considered for this purpose, with an assumption that their contribution and involvement to the agricultural development and management is considerably less. One score was assigned for every member in the family irrespective of sex and age who were aged from 12 to 70 years.

The family size includes the total persons who were effectively involved in agricultural development and management were considering the above scoring method. They were classified as small, medium and large family structures on the basis of average existing family size based on the mean (5.31) and standard deviation (2.68).

<u>Category</u>	<u>Score</u>
Small (Below $\bar{X} - \frac{1}{2}$ SD)	Below 3.97
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	3.97 to 6.65
Large (Above $\bar{X} + \frac{1}{2}$ SD)	Above 6.65

3.5.4.2 Farm size : It is defined as the extent of land possessed and available to the farmer for cultivation purpose. Data pertaining to total number of acres of dry, wet and garden lands as reported by the respondents were collected. But only the total cultivatable wet land of farmers was accounted as farm size. The farm size was determined by standard acres on the basis of "Karnataka Land Reforms Act of 1966". Depending upon the farm size, the respondents were categorized as under :

<u>Category</u>	<u>Acres (Wetland)</u>
Small farmers (Mean and below)	2.5 and below
Big farmers (Above mean)	Above 2.5

3.5.4.3 Sugarcane farming experience : It is the total number of years a farmer has cultivated sugarcane either on his own farm or leased in farm. A score of one was given to each year of experience in sugarcane cultivation. The total experience of the respondents ranged from 3 and 52 years. Later the respondents were classified as less, medium and more experienced based on the mean $\pm \frac{1}{2}$ standard deviation ($\bar{X} = 25.85$; $SD = 13.10$).

<u>Category</u>	<u>Score</u>
Less (Below $\bar{X} - \frac{1}{2} SD$)	Below 19.30
Medium ($\bar{X} - \frac{1}{2} SD$ to $\bar{X} + \frac{1}{2} SD$)	19.30 to 32.40
More (Above $\bar{X} + \frac{1}{2} SD$)	Above 32.40

3.5.4.4 Herd size : It is the number of livestock and poultry birds possessed by the respondents. The scoring pattern developed by Yogananda (1992) is followed in this study. The scoring pattern adopted is as follows :

Sl. No.	Animals	Score (for each animal)
1.	Cow	3
2.	Buffalo	3
3.	Bullock	3
4.	Sheep	2
5.	Goat	2
6.	Pig	2
7.	Poultry bird	1

The total score of the respondents ranged from 5 to 34. Based on the mean (11.60) and standard deviation (5.84), the respondents were classified into three categories.

<u>Category</u>	<u>Score</u>
Small (Below $\bar{X} - \frac{1}{2}$ SD)	Below 8.68
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	8.68 to 14.52
Large (Above $\bar{X} + \frac{1}{2}$ SD)	Above 14.52

3.5.4.5 Self-reliance : It is conceptually related to farmers' credit orientation, planning orientation and using borrowing capital for introducing changes in farming in a planned way which pre-suppose confidence in him along with a feeling that all environmental factors are not beyond one's control (Roy et al., 1968). The procedure devised by Prasad

(1983) was adopted in the present study in measuring the level of self-reliance of the sugarcane growers. 87

The question used to measure this variable was, how much of your future depends on yourself? Out of 100, would you say 100, 75, 50, 25 or nothing. The response was measured based on the following scoring pattern.

<u>Percentage response</u>	<u>Score</u>
Nothing	0
25	1
50	2
75	3
100	4

The maximum score that could be obtained was 4 and the minimum 0. To assess the degree of self-reliance of the respondents, the following categories were made based on the mean (51.37) and standard deviation (30.94).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2} SD$)	Below 35.90
Medium ($\bar{X} - \frac{1}{2} SD$ to $\bar{X} + \frac{1}{2} SD$)	35.90 to 66.84
High (Above $\bar{X} + \frac{1}{2} SD$)	Above 66.84

3.5.4.6 Input self-sufficiency : It is operationalised as the extent to which a farmer is able to meet the input

requirement of sugarcane farming from his own resources than the purchased input. It was taken as the ratio of owned inputs to the total value of inputs used in sugarcane farming. Values of inputs were worked out at the prevailing rates in that area at the time of data collection.

The input self-sufficiency index (ISSI) was calculated by using the following formula developed by Chandregowda (1996).

$$\text{ISSI} = \frac{\text{Value of owned inputs}}{\text{Total value of inputs used}} \times 100$$

Theoretically, an ISSI value of '0' indicates that the farmer was completely dependent on external inputs and a value of 100 would indicate a farmer who was completely dependent on owned inputs. In the present investigation, ISSI values ranged from 20 to 80. Based on ISSI values, the respondents were classified into three categories based on the mean (48.99) and standard deviation (18.79).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 39.59
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	39.59 to 58.38
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 58.38

3.5.4.7 Farm mechanization : This was operationalized as the possession of various machineries and implements utilized for

agricultural operations in the farm by an individual farmer. The scoring procedure followed by Trivedi (1963) was used in quantifying the mechanization as given below. The scoring method was adopted based on the possession of number of farm implements.

Sl. No.	Items	Score (for each)
1.	Wooden plough	1
2.	Iron plough	2
3.	Disc plough	2
4.	Cultivator	2
5.	Junior hoe	2
6.	Bund former	2
7.	Power tiller	3
8.	Tractor	3
9.	Trailor	2
10.	Duster	1
11.	Sprayer	1

The level of farm mechanization of the farmer was classified based on the mean (9.97) and standard deviation (3.45).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 8.24
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	8.24 to 11.69
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 11.69

3.5.4.8 Sugarcane farming commitment : It is defined as the degree to which an individual is committed to sugarcane farming as a profession.

The farming commitment scale developed by Ramegowda (1991) was used with a slight modification to suit the present investigation. The responses were obtained on a five point continuum of agreement ranging from 'strongly agree' to 'strongly disagree' for all the eight statements of the scale. The responses were quantified by giving a score of 4, 3, 2, 1 and 0 for a positive statement and 0, 1, 2, 3 and 4 for a negative statement. The minimum and maximum possible farming commitment scores were 0 and 32, respectively. The respondents were classified into three categories based on the mean (24.70) and standard deviation (9.13).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 20.13
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	20.13 to 29.26
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 29.26

3.5.4.9 Land productivity : It is operationalized as yield per unit area and was expressed in terms of tons per acre. Land productivity was taken as the average of the past three crops to give weightage to productivity over a period of time. Formula developed by Chandregowda (1996) was used in this study.

$$\text{Land productivity} = \frac{\text{Total quantity of sugarcane produced from the last three crops (tons)}}{\text{Total area under sugarcane (acre) during previous three crops}}$$

In the present investigation average land productivity values ranged from 25 tons per acre to a maximum of 82 tons per acre. The respondents were classified into three categories based on land productivity (tons per acre) of the respondents on the basis of mean $\pm \frac{1}{2}$ standard deviation ($\bar{X} = 48.31$, $SD = 10.93$).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2} SD$)	Below 42.82
Medium ($\bar{X} - \frac{1}{2} SD$ to $\bar{X} + \frac{1}{2} SD$)	42.82 to 53.80
High (Above $\bar{X} + \frac{1}{2} SD$)	Above 53.80

3.5.5 Extension Factors

3.5.5.1 Mass media use : This refers to the frequency of reading newspaper, farm magazines and literatures relating to sustainable sugarcane cultivation as well as viewing

television and listening to radio broadcast by farmers. This variable was quantified by selecting seven mass media items using the following procedure.

Scores of 'two' for regular use, 'one' for occasional use and 'zero' for non-use were assigned, separately, for each of the selected mass media items. The scores were added for all the items formed the mass media use score of the respondents. The total score of the mass media use ranged from 0 to 14.

The respondents were classified into three categories based on the mean (6.41) and standard deviation (3.38) as a measure of check.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 4.72
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	4.72 to 8.10
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 8.10

3.5.5.2 Participation in training programme : Training is one of the means by which the desired changes in knowledge and skills of farmers can be brought out. It is also possible to influence farmers' attitude through training. Training will lead to their successful performance for better agriculture. The schedule developed by Nagaraja (1989) is used in this study. For the study, the participation in training

programme by farmers during the past three years was the main consideration. The respondents were asked to indicate as to whether they have attended any training in the past three years, if so, how often. The score given for their response is indicated below.

Frequency of participation	Duration of training		
	One day	2-4 days	5 days and above
Participated once	1	2	3
Participated twice	2	4	6
Participated thrice and above	3	6	9

The total score ranged from 1 to 11 for an individual farmer.

The extent of participation in training programme by the farmers is further grouped into low, medium and high levels as shown below using the mean (5.43) and standard deviation (3.27).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 3.79
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	3.79 to 7.06
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 7.06

3.5.5.3 Farm scientist contact : It is the degree and extent of contact with the farm scientists by the farmers to seek information on farm enterprises.

To measure this variable, awareness, frequency of contact and purpose of contact of the farm scientists by farmers were considered. The scoring pattern followed is presented under.

<u>Item response</u>	<u>Score</u>
1. <u>Awareness of farm scientists</u>	
Not aware	0
Aware	1
2. <u>Frequency of contacts</u>	
Never	0
Sometimes	1
Regularly	2
3. <u>Purpose of contact</u>	
Casual	1
For technical assistance	2

The sum of all these items formed the farm scientist contact scores of the farmers. The minimum and maximum scores one can get is 0 and 5, respectively.

The farmers' farm scientist contact level was classified into low, medium and high based on the mean (2.30) and standard deviation (1.39).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 1.60
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	1.60 to 2.99
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 2.99

3.5.5.4 **Extension agency contact** : It is the degree and the extent of contact with the reforming/change agents by the farmers to seek information on farm enterprises.

To measure this variable, awareness, frequency of contact and purpose of contact of the reforming/change agents by farmers were considered. The scoring pattern followed is presented below :

<u>Item response</u>	<u>Score</u>
1. <u>Awareness of extension agents</u>	
Not aware	0
Aware	1
2. <u>Frequency of contacts</u>	
Never	0
Sometimes	1
Regularly	2
3. <u>Purpose of contact</u>	
Casual	1
For technical assistance	2

The total score of all these items formed the contact with extension agency of the respondents. The possible total score ranged from 0 to 33.

The respondents' extension contact level was classified into three categories using the mean (20.27) and standard deviation (6.70).

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 16.91
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	16.91 to 23.61
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 23.61

3.5.5.5 Extension participation : It refers to the extent of participation of the farmers in different extension programmes like training programme, group meetings etc., conducted during the year in the area. This variable was quantified by using the procedure suggested by Rattaiah (1979). A list of six extension activities was prepared and respondents were asked to indicate their extension participation for each activity. The scoring procedure adopted is as follows :

Sl. No.	Name of the extension activity	Score assigned for the pattern of participation		
		Regularly	Occasionally	Never
1.	Krishimela	2	1	0
2.	Demonstration	2	1	0
3.	Training programme	2	1	0
4.	Group meetings	2	1	0
5.	Field visits	2	1	0
6.	Field days	2	1	0

The level of extension participation using the above scoring method was classified using the mean (6.58) and standard deviation (3.76) as a measure of check.

<u>Category</u>	<u>Score</u>
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 4.70
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	4.70 to 8.46
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 8.46

3.6 Development of interview schedule

The draft interview schedule with the scale items for measuring the sustainable technologies in sugarcane farming was first developed. A sample of 30 sugarcane farmers who were not included in the study sample were interviewed with the above schedule for testing the reliability and validity.

After pretesting necessary changes were incorporated in the schedule. Then the schedule was administered for eliciting responses from sugarcane farmers. The final form of interview schedule is given in Appendix Ib.

3.7 Collection of data

Data were collected from the respondents included in the sample. The interviews were conducted during June 1997. The personal interview method was adopted under informal atmosphere. Each question was explained to the respondent during the course of interview. The onlookers' influence was avoided to a considerable extent throughout the study.

3.8 Analysis of data

The statistical tests used for analyzing the data of the investigation included, correlation co-efficient, regression, path analysis and discriminant function analysis.

3.8.1 't' test

To test the significance of correlation co-efficient 'r'.

3.8.2 Correlation and regression analysis

Correlation co-efficient is used to determine the nature of relationship among variables and regression analysis to know the extent of contribution of the selected factors (independent variables) on the dependent variable.

3.8.3 Path analysis

In finding a quantitative interpretation of direct and indirect effects of factors (independent variables) on adoption levels of sustainable sugarcane farming practices and for developing the operational model, the path analysis was employed.

According to Miller (1977) the technique of path analysis is not a method for discovering causal laws but a procedure for giving quantitative interpretation of an assumed causal system as it operates within a given population. Path co-efficients reflect the amount of direct contribution to a given variable on other variable when effects of other related variables are taken into account. The direct path co-efficients follows the order of magnitude of partial regression co-efficients of the variables. The direct co-efficients are comparable.

3.8.4 Discriminant function analysis

Simple discriminant function analysis was carried out to identify the factors (independent variables) which discriminate between high adoption level and low adoption level as well as high adoption performance and low adoption performance of sustainable sugarcane farming practices among sugarcane farmers. The analysis was done following the procedure described by Overall and Klett (1972) and

Mahalanobis D^2 method in order to find out the co-efficients for the variables included in the study.

Discriminating the personal, behavioural, motivational, situational and extention factors (independent variables) responsible for high and low adoption level of sustainable sugarcane farming practices

The mean and standard deviation were calculated for the extent of adoption of sustainable sugarcane farming practices by sugarcane farmers. The mean adoption level was 62.80 with a standard deviation of 14.91. Thus, the sugarcane farmers were grouped into three categories based on the adoption scores.

Table D. Adoption pattern of sustainable sugarcane farming practices.

Adoption pattern	Adoption score	Frequency
Low (Below $\bar{X} - \frac{1}{2}$ SD)	Below 55.34	72
Medium ($\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD)	55.34 to 70.25	64
High (Above $\bar{X} + \frac{1}{2}$ SD)	Above 70.25	64

Only low and high adoption groups were considered for the purpose of comparison and to conduct discriminant function analysis. Fischer's discriminant function analysis was applied for the purpose of finding out the relative importance of 30 selected factors (independent variables)

with regard to their power to discriminate between high and low adoption level groups.

The general mathematical model used to serve the above objective in the present study is as follows :

$$Z = L_1X_1 + L_2X_2 + L_3X_3 + L_4X_4 + L_5X_5 + L_6X_6 + L_7X_7 + L_8X_8 + \\ L_9X_9 + L_{10}X_{10} + L_{11}X_{11} + L_{12}X_{12} + L_{13}X_{13} + L_{14}X_{14} + \\ L_{15}X_{15} + L_{16}X_{16} + L_{17}X_{17} + L_{18}X_{18} + L_{19}X_{19} + L_{20}X_{20} + \\ L_{21}X_{21} + L_{22}X_{22} + L_{23}X_{23} + L_{24}X_{24} + L_{25}X_{25} + L_{26}X_{26} + \\ L_{27}X_{27} + L_{28}X_{28} + L_{29}X_{29} + L_{30}X_{30}$$

where, Z = Total discriminant score for high and low adoption level of sustainable sugarcane farming practices

X_K = Independent selected variables under different factors

L_K = Co-efficient of linear discriminant function.

i.e., $K = 1, 2, 3, 4, 5, 6 \dots 30$

Personal Factors

X_1 : Age

X_2 : Education

X_3 : Socio-economic status

Behavioural Factors

X_4 : Knowledge about sustainable sugarcane farming technologies

X_5 : Attitude towards sustainable farming

Motivational Factors

- X₆ : Management orientation
- X₇ : Risk orientation
- X₈ : Scientific orientation
- X₉ : Economic motivation
- X₁₀ : Value orientation
- X₁₁ : Achievement orientation
- X₁₂ : Level of aspiration
- X₁₃ : Innovativeness
- X₁₄ : Deferred gratification
- X₁₅ : Cosmopoliteness
- X₁₆ : Social participation

Situational Factors

- X₁₇ : Family size
- X₁₈ : Farm size
- X₁₉ : Sugarcane farming experience
- X₂₀ : Herd size
- X₂₁ : Self-reliance
- X₂₂ : Input self-sufficiency
- X₂₃ : Farm mechanization
- X₂₄ : Farming commitment
- X₂₅ : Land productivity

Extension Factors

- X₂₆ : Mass media use
 X₂₇ : Participation in training programme
 X₂₈ : Farm scientist contact
 X₂₉ : Extension agency contact
 X₃₀ : Extension participation

The method sought to obtain co-efficients (LK's) was such that the squared distance between the mean scores for the groups (Z₁) and mean scores for other groups (Z₂) was as large as possible in relation to the variation of 'Z' scores within the groups.

The Mahalanobis 'D²' statistic (Rao, 1985) was calculated to measure the distance between two extreme groups of adoption levels of sustainable sugarcane farming practices by sugarcane farmers. The 'F' statistic was employed to know whether the two groups were statistically different from each other. Further, it also focussed the attention in predicting whether the sugarcane farmers would belong to less or high groups.

$$F = \left[\frac{N_1 \cdot N_2 (N_1 + N_2 - p - 1)}{P (N_1 \cdot N_2) (N_1 + N_2 - 2)} \right] D_2$$

Where N₁ and N₂ are the samples drawn from two populations i.e., low and high adoption levels of sustainable sugarcane farming practices.

P = Number of variables considered

Discrimination function is defined as a linear function of several characteristics $d_1, d_2, \dots, d_n$ of the form.

$$D^2 = L_1 d_1 + L_2 d_2 + \dots + L_n d_n$$

where, $L_1, L_2, L_3, \dots, L_n$ are the co-efficients chosen in such a manner that.

$$\left[\frac{\text{Mean square}}{\text{Variance}} \right]^2 \quad \text{With } P \text{ and } (N_1 + NP_2 - 1) \text{ degree of freedom.}$$

RESULTS

CHAPTER IV

RESULTS

The results of the study are presented in this chapter under the following heads :

- 4.1 Profile of sustainable sugarcane farmers
- 4.2 Adoption of sustainable sugarcane farming practices by farmers
- 4.3 Relationship and contribution of personal, behavioural, motivational, situational and extension factors (independent variables) on the adoption level of sustainable sugarcane farming practices.
- 4.4 Effect of personal, behavioural, motivational, situational and extension factors contributing to the adoption of sustainable sugarcane farming practices
- 4.5 Discriminating the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices
- 4.6 Components contributing to sustainable sugarcane farming as perceived by farmers.

4.1 Profile of the sustainable sugarcane farmers

The data provided in Table I gives a detailed picture of personal, behavioural, motivational, situational and extension profile of the sustainable sugarcane farmers.

4.1.1 Personal profile : A little more than one-third of the sustainable sugarcane farmers belonged to middle age group (37 per cent), high socio-economic status (37.5 per cent) and had low education (34.5 per cent).

TABLE I

Profile of sustainable sugarcane farmers

(n = 200)

Sl. No.	Characteristics	Mean ($\bar{X}$)	Standard deviation (SD)	Sugarcane farmers	
				Number	Per cent
1	2	3	4	5	6
I. Personal Factors					
X₁. Age					
	Young (Upto 40.56 years)	47.21	13.27	66	33.0
	Middle (40.57 to 53.83 years)			74	37.0
	Old (Above 53.83 years)			60	30.0
X₂. Education					
	Low (Upto 2.40 score)	3.83	1.86	69	34.5
	Medium (2.41 to 4.26 score)			68	34.0
	High (Above 4.26 score)			63	31.5
X₃. Socio-economic status					
	Low (Upto 12.05 score)	13.03	1.89	73	36.5
	Medium (12.06 to 13.94 score)			52	26.0
	High (Above 13.94 score)			75	37.5
II. Behavioural Factors					
X₄. Knowledge about sustainable sugarcane farming technologies					
	Low (Upto 11.60 score)	13.45	3.70	68	34.0
	Medium (11.61 to 15.30 score)			71	35.5
	High (Above 15.30 score)			61	30.5
X₅. Attitude towards sustainable farming					
	Unfavourable (Upto 45.10 score)	51.52	12.83	84	42.0
	Neutral (45.11 to 57.93 score)			59	29.5
	Favourable (Above 57.93 score)			57	28.5
III. Motivational Factors					
X₆. Management orientation					
	Low (Upto 9.71 score)	11.16	2.90	69	34.5
	Medium (9.72 to 12.61 score)			59	29.5
	High (Above 12.61 score)			72	36.0

Table I contd..)

1	2	3	4	5	6
X₇.Risk orientation					
Low	(Upto 1.60 score)	2.33	1.46	68	34.0
Medium	(1.61 to 3.06 score)			84	42.0
High	(Above 3.06 score)			48	24.0
X₈.Scientific orientation					
Low	(Upto 5.31 score)	6.48	2.34	75	37.5
Medium	(5.32 to 7.65 score)			53	26.5
High	(Above 7.65 score)			72	36.0
X₉.Economic motivation					
Low	(Upto 2.20 score)	3.00	1.59	79	39.5
Medium	(2.21 to 3.79 score)			40	20.0
High	(Above 3.79 score)			81	40.5
X₁₀. Value orientation					
Low	(Upto 4.07 score)	5.22	2.29	77	38.5
Medium	(4.08 to 6.36 score)			65	32.5
High	(Above 6.36 score)			58	29.0
X₁₁.Achievement orientation					
Low	(Upto 13.40 score)	16.10	5.27	75	37.5
Medium	(13.41 to 18.73 score)			61	30.5
High	(Above 18.73 score)			64	32.0
X₁₂.Level of aspiration					
Low	(Upto 13.32 score)	15.88	5.11	73	36.5
Medium	(13.33 to 18.48 score)			68	34.0
High	(Above 18.48 score)			59	29.5
X₁₃.Innovativeness					
Low	(Upto 6.98 score)	8.78	3.59	58	29.0
Medium	(6.99 to 10.57 score)			87	43.5
High	(Above 10.57 score)			55	27.5
X₁₄.Deferred gratification					
Low	(Upto 3.49 score)	4.61	2.23	70	35.0
Medium	(3.50 to 5.72 score)			51	25.5
High	(Above 5.72 score)			79	39.5

Table I contd..)

1	2	3	4	5	6
X₁₅.Cosmopoliteness					
Low	(Upto 5.34 score)	7.09	3.50	73	36.5
Medium	(5.35 to 8.84 score)			56	28.0
High	(Above 8.84 score)			71	35.5
X₁₆.Social participation					
Low	(Upto 6.81 score)	8.55	3.47	68	34.0
Medium	(6.82 to 10.28 score)			59	29.5
High	(Above 10.28 score)			73	36.5
IV. Situational Factors					
X₁₇.Family size					
Small	(Upto 3.97 score)	5.31	2.68	60	30.0
Medium	(3.98 to 6.65 score)			78	39.0
Large	(Above 6.65 score)			62	31.0
X₁₈.Farm size					
Small	(2.5 acres and below)	-	-	109	54.5
Large	(Above 2.5 acres)			91	45.5
X₁₉.Sugarcane farming experience					
Less	(Upto 19.30 years)	25.85	13.10	68	34.0
Medium	(19.31 to 32.40 years)			65	32.5
More	(Above 32.40 years)			67	33.5
X₂₀.Herd size					
Small	(Upto 8.68 score)	11.60	5.84	58	29.0
Medium	(8.69 to 14.52 score)			96	48.0
Large	(Above 14.52 score)			46	23.0
X₂₁.Self-reliance					
Low	(Upto 35.90 score)	51.37	30.94	71	35.5
Medium	(35.91 to 66.84 score)			55	27.5
High	(Above 66.84 score)			74	37.0
X₂₂.Input self-sufficiency					
Low	(Upto 39.59 score)	48.99	18.79	77	38.5
Medium	(39.60 to 58.38 score)			65	32.5
High	(Above 58.38 score)			58	29.0

Table I contd..)

1	2	3	4	5	6
X₂₃.Farm mechanization					
Low	(Upto 8.24 score)	9.97	3.45	73	36.5
Medium	(8.25 to 11.69 score)			56	28.0
High	(Above 11.69 score)			71	35.5
X₂₄.Farming commitment					
Low	(Upto 20.13 score)	24.70	9.13	86	43.0
Medium	(20.14 to 29.26 score)			34	17.0
High	(Above 29.26 score)			80	40.0
X₂₅.Land productivity					
Low	(Upto 42.82 tons/acre)	48.31	10.93	68	34.0
Medium	(42.83 to 53.80 tons/acre)			83	41.5
High	(Above 53.80 tons/acre)			49	24.5
V. Extension Factors					
X₂₆.Mass media use					
Low	(Upto 4.72 score)	6.41	3.38	70	35.0
Medium	(4.73 to 8.10 score)			61	30.5
High	(Above 8.10 score)			69	34.5
X₂₇.Participation in training programme					
Low	(Upto 3.79 score)	3.43	3.27	69	34.5
Medium	(3.80 to 7.06 score)			52	26.0
High	(Above 7.06 score)			79	39.5
X₂₈.Farm scientist contact					
Low	(Upto 1.60 score)	2.30	1.39	61	30.5
Medium	(1.61 to 2.99 score)			43	21.5
High	(Above 2.99 score)			96	48.0
X₂₉.Extension agency contact					
Low	(Upto 16.91 score)	20.27	6.70	68	34.0
Medium	(16.92 to 23.61 score)			70	35.0
High	(Above 23.61 score)			62	31.0
X₃₀.Extension participation					
Low	(Upto 4.70 score)	6.58	3.76	60	30.0
Medium	(4.71 to 8.46 score)			70	35.0
High	(Above 8.46 score)			70	35.0

4.1.2 Behavioural profile : Most of the sustainable sugarcane farmers had medium level of knowledge (35.5 per cent) about sustainable sugarcane farming technologies and possessed unfavourable attitude (42 per cent) towards sustainable farming.

4.1.3 Motivational profile : A large number of the sustainable sugarcane farmers had high management orientation (36 per cent), medium risk orientation (42 per cent), low scientific orientation (37.5 per cent), high economic motivation (40.5 per cent), low value orientation (38.5 per cent), low achievement orientation (37.5 per cent), low aspiration (36.5 per cent), medium innovativeness (43.5 per cent), high deferred gratification (39.5 per cent), low cosmopolitaness (36.5 per cent) and high social participation (36.5 per cent).

4.1.4 Situational profile : Most of the sustainable sugarcane farmers had medium family size (39 per cent), small farms (54.5 per cent), less experience in sugarcane farming (34 per cent), medium herd size (48 per cent), high self-reliance (37 per cent), low input self-sufficiency (38.5 per cent), low farm mechanization (36.5 per cent), low farming commitment (43 per cent) and obtained medium land productivity (41.5 per cent).

4.1.5 Extension profile : A large number of the sustainable sugarcane farmers had low mass media use (35 per cent), high

participation in training programmes (39.5 per cent), high farm scientist contact (48 per cent) and medium extension agency contact (35 per cent). An equal number of sugarcane farmers (35 per cent) had medium and high extension participation.

4.2 Adoption of sustainable sugarcane farming practices by farmers

This section deals with the extent of adoption of specific sustainable sugarcane farming practices and the adoption pattern of such practices by farmers with respect to each of the eight components of sustainable sugarcane farming practices, namely, land preparation, seeds (setts) and sowing, sugarcane based cropping system, integrated nutrient management, water management, integrated pest management, ratoon management, and maturity and harvesting.

This section also deals with the overall adoption pattern (which includes the adoption of sustainable sugarcane farming practices of all the eight components) of sustainable sugarcane farming practices by farmers.

4.2.1 Land preparation

4.2.1.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Land preparation

Majority (53.5 per cent) of the sustainable sugarcane farmers had ploughed the land using bullock power, while

46.5 per cent of them had used tractor/power tiller to plough the land (Table II). Cent per cent sugarcane farmers had prepared the land into ridges and furrows for planting setts.

4.2.1.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Land preparation

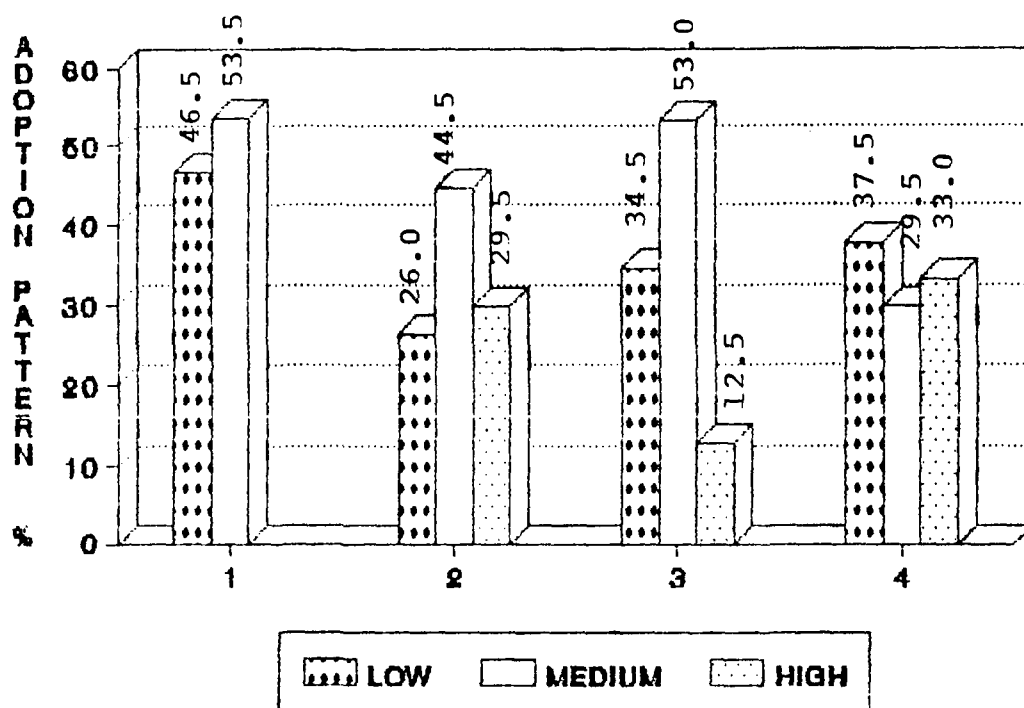
Table III points out that 53.5 and 46.5 per cent of the sustainable sugarcane farmers belonged to high and low adoption level of land preparation practices, respectively. It can be inferred from Table that majority of the sugarcane farmers belonged to high adoption level in respect of land preparation (Fig. 3).

4.2.2 Seed (setts) and sowing

4.2.2.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Seeds (setts) and sowing

Table IV reveals that all the farmers had used the recommended quantity of setts for planting. Majority of the sustainable sugarcane farmers had selected setts from main (first) crop for planting (91 per cent), selected setts with 2-3 eye buds (82 per cent), used setts of correct age for planting (80 per cent), selected top internodes as setts in the case of old and overmatured crop (66 per cent) and adopted recommended spacing (61 per cent).

FIGURE 3. ADOPTION PATTERN OF SUSTAINABLE SUGARCANE FARMING PRACTICES



1. Land preparation practices
2. Seeds (setts) and sowing practices
3. Sugarcane based cropping system practices
4. Integrated nutrient management practices

* Only two categories were observed

TABLE II

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Land preparation

(n = 200)

Sl. No.	Land preparation practices	Sugarcane farmers	
		Number	Per cent
1a.	Ploughing the land using bullock power	107	53.5
* 1b.	Ploughing the land using tractor/ power tiller	93	46.5
2.	Preparing the land into ridges and furrows for planting setts	200	100.0

* Not a sustainable practice

TABLE III

Adoption pattern of sustainable sugarcane farming
practices by farmers in respect of Land preparation

(n = 200)

* Category	Sugarcane farmers	
	Number	Per cent
Low (2.53 and below score)	93	46.5
High (Above 2.53 score)	107	53.5
- - - - - Total	200	100.0

Mean = 2.53

* Only two categories were observed

TABLE IV

Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Seeds (setts) and sowing

(n = 200)

Sl. No.	Seeds (setts) and sowing practices	Sugarcane farmers			
		Adoption		Non-adoption	
		Number	Per cent	Number	Per cent
1.	Correct age of setts (selecting setts from the crop of 8-10 months old)	160	80.0	40	20.0
2.	Recommended quantity of setts used for planting	200	100.0	-	-
3.	Selecting setts from main (first) crop for planting	182	91.0	18	9.0
4.	Selecting top internodes as setts in case of old and overmatured crop	132	66.0	68	34.0
5.	Selecting setts having 2-3 eye buds	164	82.0	36	18.0
6.	Recommended spacing given in planting setts	122	61.0	78	39.0

4.2.2.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Seeds (setts) and sowing

A perusal of Table V indicates that most number (44.5 per cent) of sustainable sugarcane farmers belong to medium level of adoption of seeds (setts) and sowing practices, while 29.5 and 26 per cent of the sugarcane farmers belong to high and low levels of adoption of seeds (setts) and sowing practices, respectively. As high as 74 per cent of the sugarcane farmers were found to be in high/medium adoption levels of seeds (setts) and sowing practices (Fig. 3).

4.2.3 Sugarcane based cropping system

4.2.3.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Sugarcane based cropping system

Less than 20 per cent of the sustainable sugarcane farmers did adopt crop rotation practices in sugarcane (Table VI). Legume crop was grown before cane was planted by 19 per cent of the sugarcane farmers, while 14.5 per cent of the sugarcane farmers did grow legume/ragi after cane was harvested.

Further, the results reveals that a majority (63 per cent) of the sugarcane farmers had grown legume as an intercrop in sugarcane fields. About 37 per cent of

TABLE V

Adoption pattern of sustainable sugarcane farming
practices in respect of Seeds (setts) and sowing

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 5.48 score)	52	26.0
Medium	(5.49 to 6.49 score)	89	44.5
High	(Above 6.49 score)	59	29.5
Total		200	100.0
Mean = 5.99		Standard deviation = 1.00	

TABLE VI

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Sugarcane based cropping system

(n = 200)

Sl. No.	Sugarcane based cropping system practices	Sugarcane farmers			
		Adoption		Non-adoption	
		Number	Per cent	Number	Per cent
1. Crop rotation					
1a.	Legumes are grown before sugarcane was planted	38	19.0	162	81.0
1b.	Legumes/Ragi are/is grown after sugarcane was harvested	29	14.5	171	85.5
2. Intercropping					
2a.	Legumes are grown as an intercrop in sugarcane fields	126	63.0	74	37.0

sugarcane farmers had not grown legume as an intercrop in sugarcane fields.

4.2.3.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Sugarcane based cropping system

Table VII indicates that majority (53 per cent) of the sustainable sugarcane farmers were found to be in medium level of adoption of sugarcane based cropping system practices, while 34.5 and 12.5 per cent of the sugarcane farmers were found to be in low and high levels of adoption of sugarcane based cropping system practices, respectively. As high as 87.5 per cent of the sugarcane farmers belonged to low/medium adoption levels of sugarcane based cropping system practices (Fig. 3).

4.2.4 Integrated nutrient management

4.2.4.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated nutrient management

The data provided in Table VIII gives a detailed picture of the extent of adoption of integrated nutrient management practices adopted by sustainable sugarcane farmers.

4.2.4.1.1 Soil testing

Only a microscopic part of the sugarcane farmers (5 per cent) tested the soil before planting the main (first) crop

TABLE VII

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Sugarcane based cropping system

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 0.59 score)	69	34.5
Medium	(0.60 to 1.57 score)	106	53.0
High	(Above 1.57 score)	25	12.5
Total		200	100.0
Mean = 1.00		Standard deviation = 0.90	

TABLE VIII

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Integrated nutrient management
(n = 200)

Sl. No.	Integrated nutrient management practices	Sugarcane farmers	
		Number	Per cent
1	2	3	4
A. Testing soil before planting main (first) crop			
1.	Tested	10	5.0
2.	Not tested	190	95.0
B. Application of organic manures :			
1. Application of farm yard manure/compost :			
(a) Quantity used per acre			
i)	Complete adoption	92	46.0
ii)	Partial adoption	106	53.0
iii)	Non-adoption	2	1.0
(b) Time of application (N = 198)			
i)	Applied 1-3 weeks before planting setts as recommended	190	96.0
* ii)	Applied at an inappropriate time	8	4.0
(c) Method of application			
* i)	Mixed with soil as recommended	161	81.0
ii)	Spread on the soil surface	37	19.0
(d) Application of farm yard manure to all plots equally			
i)	Adoption	198	100.0
ii)	Non-adoption	-	-
2. Application of green leaf manure			
(a) i)	Adoption	69	34.5
ii)	Non-adoption	131	65.5

* Not a sustainable practice

Table VIII contd...)

1	2	3	4
(b) Time of application (N = 69)			
i) Trampling 1-2 weeks before planting setts as recommended		39	56.5
* ii) Trampling at an inappropriate time		30	43.5
(c) Application of green leaf manure to all plots equally			
i) Adoption		69	100.0
ii) Non-adoption		-	-
3. Application of bio-fertilizers (Azotobacter/ Azospirillum) :			
(a) Quantity applied per acre			
i) Complete adoption		53	26.5
ii) Partial adoption		117	58.5
iii) Non-adoption		30	15.0
(b) Number of times applied (N = 170)			
i) Two or more times at an interval of 30 days after planting as recommended		53	31.0
* ii) Applied only once		117	69.0
(c) Method of application			
i) Applied by opening small furrow near clumps and covering by soil as recommended		63	37.0
* ii) Spread over soil surface		107	63.0
(d) Application of bio-fertilizers equally to all plots			
i) Adoption		170	100.0
ii) Non-adoption		-	-

* Not a sustainable practice

Table VIII contd..)

1	2	3	4
4. Application of crop residues (cane stubbles and leaf trash)			
(a) i) Adoption	2	1.0	
ii) Non-adoption	198	99.0	
(b) Use of stubbles	-	-	
(c) Use of leaf trash	2	1.0	
(d) Use of stubbles and leaf trash	-	-	
(e) Application of crop residues to all plots equally (N = 2)			
i) Adoption	2	100.0	
ii) Non-adoption	-	-	
5. Application of press mud			
(a) Quantity applied per acre			
i) Complete adoption	2	1.0	
ii) Partial adoption	102	51.0	
iii) Non-adoption	96	48.0	
(b) Time of application (N = 104)			
i) Applied 2-3 weeks before planting setts as recommended	78	75.0	
* ii) Applied at an inappropriate time	26	25.0	
(c) Method of application			
i) Mixed with soil thoroughly as recommended	82	79.0	
* ii) Spread on soil surface	22	21.0	
(d) Application of press mud to all plots equally			
i) Adoption	104	100.0	
ii) Non-adoption	-	-	

* Not a sustainable practice

Table VIII contd..)

1	2	3	4
C. Application of inorganic manure (fertilizers)			
(a) Quantity used			
i) Complete adoption	109	54.5	
ii) Partial adoption	91	45.5	
iii) Non-adoption	-	-	
(b) Quantity of Nitrogenous (N) fertilizers used			
i) Complete adoption	181	90.5	
ii) Partial adoption	19	9.5	
iii) Non-adoption	-	-	
(c) Quantity of Phosphorus (P₂O₅) fertilizers used			
i) Complete adoption	109	54.5	
ii) Partial adoption	91	45.5	
iii) Non-adoption	-	-	
(d) Quantity of Potash (K₂O) fertilizers used			
i) Complete adoption	138	69.0	
ii) Partial adoption	62	31.0	
iii) Non-adoption	-	-	
(e) Time of application of fertilizers (N = 200)			
i) Use of NPK as basal dose at the time of planting setts	200	100.0	
ii) Use of Nitrogenous fertilizers as first top dressing after 6 weeks of planting setts	200	100.0	
iii) Use of Nitrogenous fertilizer as second top dressing after 10 weeks of planting setts	171	85.5	
iv) Use of Nitrogenous fertilizer as third top dressing after 14 weeks of planting setts	109	54.5	

Table VIII contd..)

1	2	3	4
(f) Method of application of fertilizers			
i) Applied fertilizers in furrows, opened on either side of crop rows and then covered by soil as recommended		141	70.5
* ii) Applied on standing water in the sugarcane field		59	29.5
(g) Application of fertilizers equally to all plots			
i) Adoption		200	100.0
ii) Non-adoption		-	-
D. Application of micronutrients (only iron deficiency was noticed in sugarcane fields)			
(a) i) Soils not affected by iron deficiency		153	76.5
ii) Soils affected by iron deficiency		47	23.5
(b) Application of ferrous sulphate to soils affected by iron deficiency (N = 47)			
i) Adoption		21	45.0
ii) Non-adoption		26	55.0
E. Application of soil amendments (Gypsum/lime)			
(a) i) Soils not affected by salt		105	52.5
ii) Soils affected by salt		95	47.5
(b) Application of soil amendments to soils affected by salt (N = 95)			
i) Grown salt tolerant variety (Co-62175)		70	74.0
ii) Adoption of soil ammendments		12	12.5
iii) Non-adoption of any control measures		13	13.5

* Not a sustainable practice

as recommended, while a big majority (95 per cent) of the sugarcane farmers had not tested the soil before planting the main (first) crop.

4.2.4.1.2 Application of organic manures

4.2.4.1.2.1 Application of farm yard manure/compost : Vast majority (99 per cent) of the sustainable sugarcane farmers had applied farm yard manure/compost. More than half of the sugarcane farmers (53 per cent) had partially adopted, while 46 per cent of the sugarcane farmers had completely adopted the recommended quantity of farm yard manure/compost. Only one per cent of the sugarcane farmers had not applied farm yard manure/compost to their sugarcane crop.

A great majority of the sugarcane farmers who had applied farm yard manure/compost had followed the recommended time of application (96 per cent) and method of application (81 per cent). All the farmers had distributed farm yard manure/compost to all the sugarcane plots equally.

4.2.4.1.2.2 Application of green leaf manure : Nearly two-thirds of the sustainable sugarcane farmers (65.5 per cent) had not applied green leaf manure to their sugarcane crop. Only 34.5 per cent of them had applied green leaf manure to sugarcane. About 56.5 per cent of the sugarcane farmers who had applied green leaf manure have followed the correct time of application and all the farmers who had applied green leaf manure had distributed it to all the plots equally.

4.2.4.1.2.3 Application of biofertilizers (Azotobacter/Azospirillum) : A great majority (85 per cent) of the sustainable sugarcane farmers had applied biofertilizers to sugarcane crop. Out of this, more than half of the sugarcane farmers (58.5 per cent) had partially adopted, while 26.5 per cent of them had completely adopted the recommended quantity of biofertilizers. About 15 per cent of the sugarcane farmers had not applied biofertilizers to sugarcane crop.

About 31 per cent of the sugarcane farmers who had used biofertilizers had applied twice to sugarcane crop as recommended, while majority (69 per cent) of them had applied only once. It was applied by opening small furrows near the clumps and covered by 37 per cent of the farmers, while majority (63 per cent) of the sugarcane farmers had spread it over the soil surface. All the sugarcane farmers who had applied the biofertilizers, had distributed it equally to all plots.

4.2.4.1.2.4 Application of crop residues (cane stubbles and leaf trash) : Almost all the sustainable sugarcane farmers (99 per cent) did not apply crop residues to sugarcane crop. Only one per cent of the sugarcane farmers had applied leaf trash to sugarcane and it was distributed to all plots equally.

4.2.4.1.2.5 Application of press mud : More than half of the sugarcane farmers (52 per cent) had applied press mud, while

48 per cent of them had not applied press mud to sugarcane crop.

Among the adopters 51 per cent of the sugarcane farmers had partially adopted the recommended quantity of press mud, while only one per cent of them had completely adopted the recommended quantity of press mud to sugarcane crop. Press mud is recommended to be applied 2-3 weeks before planting setts and it was done by 75 per cent of the sugarcane farmers who had used press mud, while 25 per cent of them had applied it at an inappropriate time. Majority (79 per cent) of the sugarcane farmers had mixed the press mud to soil thoroughly as recommended. All the sugarcane farmers who had applied press mud had distributed it to all the plots equally.

4.2.4.1.3 Application of inorganic manure (fertilizers) : Fertilizer application as recommended was completely adopted by 54.5 per cent of the sustainable sugarcane farmers. On the contrary, 45.5 per cent of the sugarcane farmers had partially adopted the recommended quantity of fertilizer.

Majority of the sugarcane farmers had completely adopted the recommended quantity of fertilizers in respect of nitrogen (90.5 per cent), phosphorus (54.5 per cent) and potash (69 per cent).

All the farmers had applied the NPK as basal dose at the time of planting setts as recommended. The first top

dressing of nitrogenous fertilizers was done by 100 per cent of the sugarcane farmers, while second top dressing was done by 85.5 per cent followed by third top dressing being done by only 54.5 per cent of the farmers.

Majority of over 70 per cent of the sugarcane farmers had followed the right method of application of fertilizers. Cent per cent sugarcane farmers had distributed the fertilizers to all plots equally.

4.2.4.1.4 Application of micronutrients (only iron deficiency was noticed in sugarcane) : Vast majority (76.5 per cent) of the sustainable sugarcane farmers did not have iron deficiency in their soils. Only 23.5 per cent of them had such problem. Among the farmers who had iron deficiency in their soils, about 45 per cent of them applied ferrous sulphate to combat iron deficiency and majority (55 per cent) of the sugarcane farmers did not take up any control measures.

4.2.4.1.5 Application of soil amendments (gypsum/lime) : Majority (52.5 per cent) of the sustainable sugarcane farmers did not have their soil affected by salts, while 47.5 per cent of the sugarcane farmers had the salt problem in their lands. Among the farmers whose soil was affected by salts, vast majority (74 per cent) of them had grown salt tolerant variety of sugarcane (Co-62175) and about 12.5 per cent of

the sugarcane farmers had used soil amendments to overcome the salt problem. Only 13.5 per cent of the sugarcane farmers did not take up any measures to overcome the salt problem.

4.2.4.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Integrated nutrient management

Table IX reveal that 37.5 per cent of the sustainable sugarcane farmers were low adopters of integrated nutrient management practices. On the contrary, 33 and 29.5 per cent of the sugarcane farmers belonged to high and medium levels of adoption of integrated nutrient management practices, respectively. As high as 62.5 per cent of the farmers belonged to high/medium levels of integrated nutrient management practices (Fig. 3).

4.2.5 Water management

4.2.5.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Water management

The adoption of sustainable sugarcane farming practices by farmers in respect of water management is depicted in Table X.

4.2.5.1.1 Frequency and method of irrigation : The research area comprised of red soils. Vast majority (75.5 per cent) of sustainable sugarcane farmers had irrigated the sugarcane

TABLE IX

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Integrated nutrient management

(n = 200)

Category	Sugarcane farmers	
	Number	Per cent
Low (Upto 20.13 score)	75	37.5
Medium (20.14 to 27.87 score)	59	29.5
High (Above 27.87 score)	66	33.0

Total	200	100.0

Mean = 24.00	Standard deviation = 7.74	

TABLE X

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Water management

(n = 200)

Sl. No.	Water management practices	Sugarcane farmers	
		Number	Per cent
1	2	3	4
1. Frequency of irrigation adopted in red soils			
	(a) Once in 5-8 days as recommended	151	75.5
	(b) Once in 9-15 days	36	18.0
	(c) Once in more than 15 days	13	6.5
2. Method of irrigation			
	(a) Followed furrow method	200	100.0
	(b) Followed other than furrow method	-	-
3. Water management practices for salt affected soils			
	(a) Soil not affected by salt	105	52.5
	(b) Soil affected by salt (N = 95, but multiple responses are possible)	95	47.5
	i) Changed the salt affected water and allowed fresh water frequently in the case of soil affected by salt	95	100.0
	ii) Grown salt tolerant sugarcane variety (Co-62175)	70	74.0
4. Water management practices under water shortage/deficit condition			
	(a) Water shortage not experienced	89	44.5
	(b) Experienced water shortage condition (N = 111)	111	55.5
	i) Practised trash mulching to overcome water deficit	2	2.0
	ii) Applied 25 per cent extra potash to overcome water deficit	7	6.5
	iii) Did not take any measure to conserve moisture in soil	102	91.5

Table X contd..)

1	2	3	4
5. Water management practices under excess water/water logged condition			
(a) Excess water/water logged condition not experienced		111	55.5
(b) Experienced excess water/water logged condition (N = 89, but multiple responses are possible)		89	44.5
i) Provision of diversion drains to drain out excess water to overcome water logged condition		89	100.0
ii) Grown salt tolerant sugarcane variety (Co-62175) to overcome waterlogged/excess water condition		70	78.5

crop once in 5-8 days as recommended, while 18 and 6.5 per cent of them had irrigated the sugarcane crop once in 9-15 days and once in more than 15 days, respectively. All the sugarcane farmers had followed the furrow method of irrigation.

4.2.5.1.2 Water management practices adopted by farmers in salt affected soils : In majority (52.5 per cent) of the sustainable sugarcane farmers, their soil was not affected by salt. The remaining 47.5 per cent of the sugarcane farmers had their soil affected by salt. All the sugarcane farmers whose soils were affected by salts, had changed the salt affected soil by allowing fresh water to reduce the salts in their soil, while 74 per cent of the sugarcane farmers had grown salt tolerant variety (Co-62175) to combat salt problem in their soils.

4.2.5.1.3 Water management practices adopted by farmers to overcome water deficit/shortage condition : Majority (55.5 per cent) of the sustainable sugarcane farmers had experienced water shortage during sugarcane cultivation, while 44.5 per cent of them did not experience any water deficiency.

Among the sugarcane farmers who experienced water shortage, vast majority (91.5 per cent) of them did not take any measures to conserve the moisture in soil. Only 6.5 per

cent of the sugarcane farmers applied 25 per cent excess potash fertilizers and two per cent of them had practised trash mulching to conserve moisture in the soil.

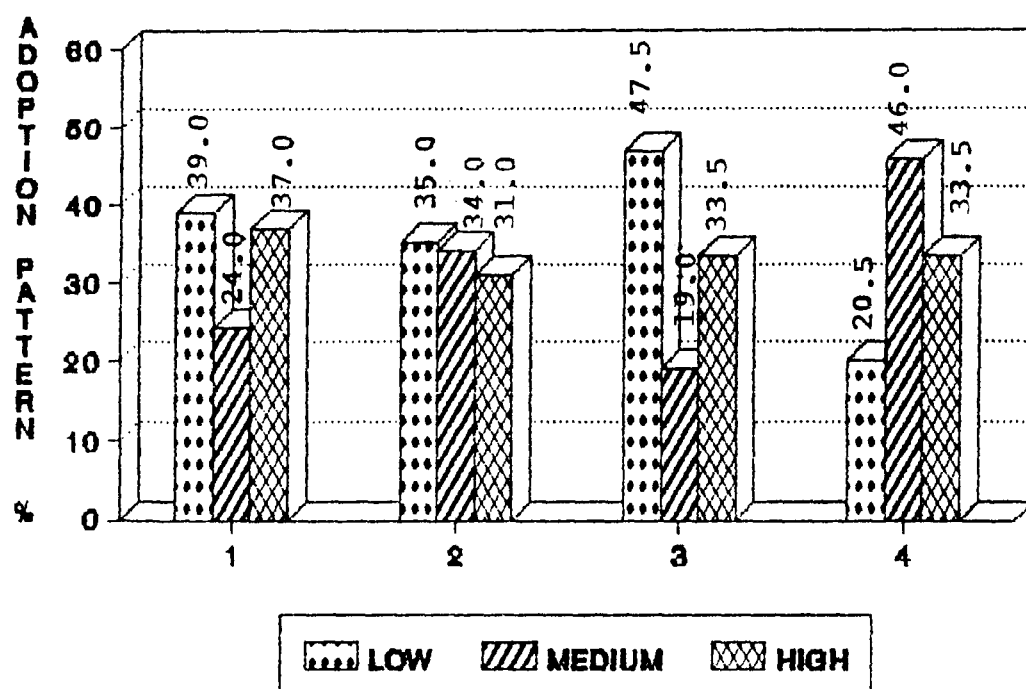
4.2.5.1.4 Water management practices adopted by farmers to overcome excess water/water logged condition : About 44.5 per cent of the sustainable sugarcane farmers had experienced excess water/water logged condition, while majority (55.5 per cent) of them did not experience such problem in their fields.

Among the farmers who experienced water logged/excess water condition, all the farmers had provided diversion drains to drain out excess water from the fields. About 78.5 per cent of farmers had grown salt tolerant sugarcane variety (Co-62175) which could tolerate excess water condition in the fields.

4.2.5.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Water management

Table XI indicates that 39 per cent of the sustainable sugarcane farmers were in low level of adoption of water management practices. The other 37 per cent of sugarcane farmers were in high level of adoption of water management practices. The remaining 24 per cent belonged to medium level of adoption of water management practices. It can be inferred that majority (61 per cent) belonged to high/medium levels of adoption of water management practices (Fig. 4).

FIGURE 4. ADOPTION PATTERN OF SUSTAINABLE SUGARCANE FARMING PRACTICES



1. Water management practices
2. Integrated pest management practices
3. Ratoon management practices
4. Maturity and Harvesting practices.

TABLE XI

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Water management

(n = 200)

Category	Sugarcane farmers	
	Number	Per cent
Low (Upto 10.31 score)	78	39.0
Medium (10.32 to 13.49 score)	48	24.0
High (Above 13.49 score)	74	37.0

Total	200	100.0

Mean = 11.90	Standard deviation = 3.18	

4.2.6 Integrated pest management

4.2.6.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated pest management

Data in Table XII presents the extent of adoption of sustainable sugarcane farming practices by farmers in respect of integrated pest management. It has got three subcomponents, namely, integrated weed management, integrated disease management and integrated insect management.

4.2.6.1.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated weed management

All the sustainable sugarcane farmers noticed infestation of weeds in their sugarcane fields. Majority (50.5 per cent) of the sugarcane farmers controlled the weeds by hand weeding, while 30 and 19.5 per cent of them controlled weeds by practising intercultural operations and by using herbicides, respectively.

4.2.6.1.2 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated disease management

All the sustainable sugarcane farmers had used disease free seed material (setts) for planting. Majority (78.5 per cent) of them used hot water treated setts for planting. The diseased yellow clumps were uprooted and burnt by 33.5 per cent of the sugarcane farmers.

TABLE XII

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Integrated pest management

(n = 200)

Sl. No.	Integrated pest management practices	Sugarcane farmers	
		Number	Per cent
1	2	3	4
I. Integrated weed management practices			
1.	Sugarcane plots free from infestation of weeds	-	-
2.	Sugarcane plots with infestation of weeds	200	100.0
	(a) Controlled weeds by intercul- tural operations	60	30.0
	(b) Controlled weeds by hand weeding	101	50.5
	(c) Controlled weeds by using herbicides	39	19.5
II. Integrated disease management practices			
1.	Use of disease free seed material (setts) for planting	200	100.0
2.	Use of hot water treated setts	157	78.5
3.	Uprooting and burning the disease affected yellow clumps	67	33.5
4.	Control of brown leaf spot disease		
	(a) Sugarcane plots free from brown leaf spot disease	72	36.0
	(b) Sugarcane plots with brown leaf spot disease problem (N = 128)	128	64.0
	i) Provision of good drainage for excess water to drain off to free the crop from leafspot disease	78	61.0
	ii) Application of 25 per cent excess potash fertilizers to free the crop from leaf spot disease	7	5.5
	iii) No control measures adopted	43	33.5

Table XII contd..)

1	2	3	4
III. Integrated insect management practices			
A. Control of termites			
1. Sugarcane plots free from termites	146	73.0	
2. Sugarcane plots with termite problem (N = 54)	54	27.0	
i) Catching the termite queen and destroying it to control termites	-	-	
ii) Frequently irrigating the crops to control termites	34	63.0	
iii) Control of termites by using chemicals	20	37.0	
B. Control of early shoot borer			
1. Sugarcane plots free from early shoot borer	83	41.5	
2. Sugarcane plots with early shoot borer problem (N = 117)	117	58.5	
(a) Control of early shoot borer by practising mulching	2	2.0	
(b) Control by practising earthening up operation	15	12.5	
(c) Control by adopting biological control method using <u>Trichogramma</u> egg parasites (n = 100)	100	85.5	
(i) Release of <u>Trichogramma</u> egg parasites in five batches as recommended	49	49.0	
* (ii) Release of <u>Trichogramma</u> egg parasites in less than five batches	51	51.0	
(iii) Release of <u>Trichogramma</u> egg parasites at proper time as recommended	40	40.0	
* (iv) Release of <u>Trichogramma</u> egg parasites at an inappropriate time	60	60.0	

* Not a sustainable practice

About 64 per cent of the sustainable sugarcane farmers noticed brown leaf spot disease in sugarcane crop. The other 36 per cent of them did not notice the attack of brown leaf spot disease on their sugarcane crop. Among the sugarcane farmers who noticed brown leaf spot disease, majority (61 per cent) of the sugarcane farmers provided good drainage and 5.5 per cent of them applied 25 per cent excess potash fertilizers to control the brown leaf spot disease as per recommendation. Control measures were not adopted by 33.5 per cent of the sugarcane farmers against brown leaf disease.

4.2.6.1.3 Extent of adoption of sustainable farming practices by farmers in respect of Integrated insect management

As high as 73 per cent of the sustainable sugarcane farmers did not have the problem of termites in their sugarcane crop. Only 27 per cent of them had that problem.

Among the farmers who had termite problem on their sugarcane crop, majority (63 per cent) of the sugarcane farmers controlled the termites by providing frequent irrigations and the remaining 37 per cent controlled it by applying chemicals (Heptachlor). None of the farmers controlled termites by collecting and destroying the termite queen.

Majority (58.5 per cent) of the sugarcane farmers had the problem of early shoot borer on sugarcane crop, while

41.5 per cent of them had no such problem. Among the farmers who had the problem of early shoot borer on sugarcane crop, vast majority (85.5 per cent) of them had controlled it by adopting biological measures (release of *Trichogramma* egg parasites). About 12.5 per cent of the farmers had practised earthening up of operation and another two per cent of them had practised mulching to overcome the problem of early shoot borer.

Out of 100 sugarcane farmers who released *Trichogramma* egg parasites to control early shoot borer, only 49 per cent of them had released it in five batches as recommended and the other 51 per cent of the farmers had released it in less than five batches. The recommended time of release of *Trichogramma* egg parasites were followed by only 40 per cent of the farmers, while majority (60 per cent) had released it at an inappropriate time.

4.2.6.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Integrated pest management

A birds eye view of Table XIII reveals that 35 per cent of the sustainable sugarcane farmers were in low level of adoption of integrated pest management practices. On the contrary, 34 and 31 per cent of the sugarcane farmers were in medium and high adoption levels of integrated pest management practices, respectively. As high as 65 per cent

TABLE XIII

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Integrated pest management

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 10.31 score)	70	35.0
Medium	(10.32 to 13.49 score)	68	34.0
High	(Above 13.49 score)	62	31.0
Total		200	100.0

Mean = 11.90

Standard deviation = 3.10

of the farmers fall under high/medium adoption levels of integrated pest management practices (Fig. 4).

4.2.7 Ratoon management

4.2.7.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Ratoon management

Table XIV presents a detailed picture of the extent of adoption of sustainable sugarcane farming practices by farmers in respect of ratoon management.

Ratooning in sugarcane should be practised from the crop harvested between June and November months. Majority (68 per cent) of the sustainable sugarcane farmers had practised it. All the sugarcane farmers performed gap filling operation. About 91 and 85.5 per cent of the sugarcane farmers performed shoulder breaking and stubble shaving operations, respectively. Only one per cent of the sugarcane farmers incorporated leaf trash to the ratoon sugarcane crop which is a recommended sustainable practice.

Vast majority (92.5 per cent) of the sustainable sugarcane farmers applied farm yard manure/compost to their ratoon crop. The remaining 7.5 per cent of them did not apply farm yard manure/compost. Among the sugarcane farmers who had applied farm yard manure/compost, majority (72.5 per cent) of the farmers had applied less than the recommended quantity and only 20 per cent of them had applied complete

TABLE XIV

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Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Ratoon management (n = 200)

Sl. No.	Ratoon management practices	Sugarcane farmers	
		Number	Per cent
A. 1.	Practised ratooning from June to November harvested sugarcane crop as recommended	136	68.0
2.	Performing gap filling operation	200	100.0
3.	Incorporation of leaf trash to ratoon fields	2	1.0
4.	Performing stubble shaving operation	171	85.5
5.	Performing shoulder breaking operation	182	91.0
B.	Integrated nutrient management practices in ratoon		
1.	Application of organic manure (farm yard manure/compost)		
	a) Quantity used		
	i) Complete adoption	40	20.0
	ii) Partial adoption	145	72.5
	iii) Non-adoption	15	7.5
2.	Application of inorganic manure (fertilizers)		
	(a) Quantity used		
	i) Complete adoption	87	43.5
	ii) Partial adoption	103	51.5
	iii) Non-adoption	10	5.0
	(b) Application of fertilizers at an appropriate time as recommended (N = 190)	109	57.5
	(c) Application of fertilizers in furrows on either side of crop rows and covered by soil as recommended	141	74.0
	(d) Application of fertilizers to all plots equally	190	100.0

dose of recommended quantity of farm yard manure/compost to ratoon sugarcane crop.

Fertilizers as recommended was applied by 43.5 per cent of the sustainable sugarcane farmers, while more than half of them (51.5 per cent) had partially adopted the recommended quantity to ratoon crop. Only five per cent of the farmers did not apply any fertilizers to ratoon sugarcane crop. Among the sugarcane farmers who had applied fertilizers to ratoon crop, about 57.5 and 74 per cent of them had followed the right time and correct method of application of fertilizers, respectively. All the farmers had distributed fertilizers to the sugarcane plots equally.

4.2.7.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Ratoon management

It is evident from Table XV that a little less than half of the sustainable sugarcane farmers (47.5 per cent) were found to be in low adoption level of ratoon management practices, whereas 33.5 and 19 per cent of them belonged to high and medium adoption levels of ratoon management practices, respectively (Fig. 4).

TABLE XV

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Ratoon management

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 7.33 score)	95	47.5
Medium	(7.34 to 9.37 score)	38	19.0
High	(Above 9.37 score)	67	33.5
Total		200	100.0

Mean = 8.85

Standard deviation = 2.04

4.2.8 Maturity and Harvesting

4.2.8.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Maturity and Harvesting

A perusal of data presented in Table XVI indicates that all the sustainable sugarcane farmers had judged the maturity of the sugarcane crop for timely harvest. Majority (75 per cent) of the sugarcane farmers had judged the maturity of crop based on their experience, while 15 and 10 per cent of them had judged the maturity of crop based on sucrose content in the juice and by trial boiling of juice, respectively.

The matured sugarcane crop was harvested by majority (63 per cent) of the sugarcane farmers, while 37 per cent of them were not able to harvest the crop when it was matured. The sugarcane crop was harvested at ground level by 69 per cent of the sugarcane farmers, while 31 per cent of them did not harvest the crop at ground level.

4.2.8.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Maturity and Harvesting

As indicated in Table XVII, 46 per cent of the sustainable sugarcane farmers were found to be in medium level of adoption of maturity and harvesting practices, whereas 33.5 and 20.5 per cent of them belonged to high and low levels of adoption of maturity and harvesting practices,

TABLE XVI

Extent of adoption of sustainable sugarcane farming practices
by farmers in respect of Maturity and Harvesting

(n = 200)

Sl. No.	Maturity and Harvesting practices	Sugarcane farmers	
		Number	Per cent
1.	Judging maturity of sugarcane crop for timely harvest	200	100.0
	(a) Judging the maturity of the sugarcane crop based on experience	150	75.0
	(b) Judging the maturity of the sugarcane crop by examining sucrose content in the juice	30	15.0
	(c) Judging the maturity of the sugarcane crop by trial boiling of juice for jaggery preparation	20	10.0
2.	Harvested the sugarcane crop when, it was matured	126	63.0
3.	Harvested the sugarcane crop at ground level to get optimum yield	138	69.0

TABLE XVII

Adoption pattern of sustainable sugarcane farming practices
by farmers in respect of Maturity and Harvesting

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 1.76 score)	41	20.5
Medium	(1.77 to 2.48 score)	92	46.0
High	(Above 2.48 score)	67	33.5
Total		200	100.0

Mean = 2.12

Standard deviation = 0.72

respectively. It can be inferred that vast majority (79.5 per cent) of the farmers belonged to high/medium levels of adoption of maturity and harvesting practices (Fig. 4).

4.2.9 Overall adoption pattern of sustainable sugarcane farming practices by farmers

The results presented in Table XVIII indicated that 36 per cent of the sustainable sugarcane farmers were found to be in low level of overall adoption of sustainable sugarcane farming practices, while the remaining (64 per cent) were halved between medium and high levels of overall adoption of sustainable sugarcane farming practices. As high as 64 per cent of the sustainable sugarcane farmers were high/medium adopters of sustainable sugarcane farming practices (Fig. 5).

4.3 Relationship and contribution of personal, behavioural, motivational, situational and extension factors (independent variables) on the adoption level of sustainable sugarcane farming practices

4.3.1 Relationship between personal, behavioural, motivational, situational and extension factors and the adoption level of sustainable sugarcane farming practices

In order to measure the relationship that exists between the personal, behavioural, motivational, situational and extension factors and the adoption level of sustainable sugarcane farming practices, the correlation coefficients were worked out and tested for its statistical significance.

FIGURE 5: OVERALL ADOPTION PATTERN OF SUSTAINABLE SUGARCANE FARMING PRACTICES

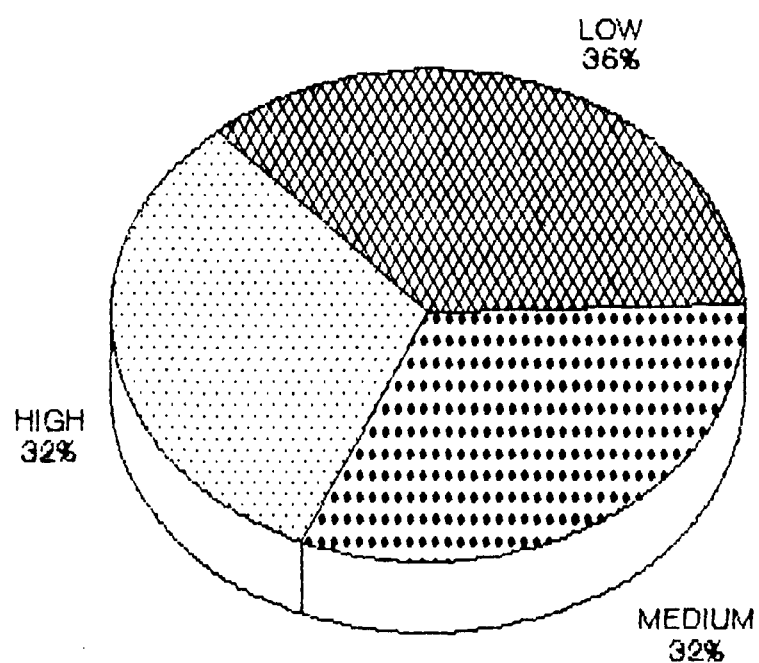


TABLE XVIII

Overall adoption pattern of sustainable sugarcane
farming practices by farmers

(n = 200)

Category		Sugarcane farmers	
		Number	Per cent
Low	(Upto 55.34 score)	72	36.0
Medium	(55.35 to 70.25 score)	64	32.0
High	(Above 70.25 score)	64	32.0
Total		200	100.0

Mean = 62.00

Standard deviation = 14.90

The correlation coefficients of 30 independent variables with the adoption level of sustainable sugarcane farming practices are presented in Table XIX. It could be observed from the Table that eleven variables were found to have a non-significant relationship with the adoption level, while four and fifteen variables were found to have significant relationship at 5 per cent and at 1 per cent level, respectively with the adoption level of sustainable sugarcane farming practices.

Management orientation (X_6), risk orientation (X_7), scientific orientation (X_8), value orientation (X_{10}), innovativeness (X_{13}), deferred gratification (X_{14}), cosmopoliteness (X_{15}), social participation (X_{16}), family size (X_{17}), herd size (X_{20}) and farm mechanization (X_{23}) had non-significant relationship.

Achievement orientation (X_{11}), level of aspiration (X_{12}), self-reliance (X_{21}) and farm scientist contact (X_{28}) had significant relationship at 5 per cent level, while age (X_1), education (X_2), socio-economic status (X_3), knowledge about sustainable sugarcane farming technologies (X_4), attitude towards sustainable farming (X_5), economic motivation (X_9), farm size (X_{18}), sugarcane farming experience (X_{19}), input self-sufficiency (X_{22}), farming commitment (X_{24}), land productivity (X_{25}), mass media use (X_{26}), participation in training programme (X_{27}), extension

TABLE XIX

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Relationship between personal, behavioural, motivational, situational and extension factors and the adoption level of sustainable sugarcane farming practices

Groups	Selected factors	Correlation (r) with adoption level
I Personal Factors		
X ₁	Age	0.2192**
X ₂	Education	0.3616**
X ₃	Socio-economic status	0.2141
II Behavioural Factors		
X ₄	Knowledge about sustainable sugarcane farming technologies	0.8130**
X ₅	Attitude towards sustainable farming	0.5230**
III Motivational Factors		
X ₆	Management orientation	0.0100
X ₇	Risk orientation	0.0823
X ₈	Scientific orientation	0.0790
X ₉	Economic motivation	0.2746**
X ₁₀	Value orientation	0.0576*
X ₁₁	Achievement orientation	0.1476*
X ₁₂	Level of aspiration	0.1461
X ₁₃	Innovativeness	0.1030
X ₁₄	Deferred gratification	0.0482
X ₁₅	Cosmopolitaness	0.0803
X ₁₆	Social participation	0.0258
IV Situational Factors		
X ₁₇	Family size	0.0362**
X ₁₈	Farm size	0.4411**
X ₁₉	Sugarcane farming experience	0.2456
X ₂₀	Herd size	0.0810*
X ₂₁	Self-reliance	0.1478**
X ₂₂	Input self-sufficiency	0.4184
X ₂₃	Farm mechanization	0.0111**
X ₂₄	Farming commitment	0.3167**
X ₂₅	Land productivity	0.2403
V Extension Factors		
X ₂₆	Mass media use	0.2923**
X ₂₇	Participation in training programme	0.2508*
X ₂₈	Farm scientist contact	0.1731**
X ₂₉	Extension agency contact	0.2361**
X ₃₀	Extension participation	0.4889

* = Significant at 5 per cent level

** = Significant at 1 per cent level

Rest of them are non-significant

agency contact (X_{29}) and extension participation (X_{30}) had highly significant relationship (1 per cent level) with the adoption level of sustainable sugarcane farming practice.

4.3.2 Contribution of personal, behavioural, motivational, situational and extension factors on the adoption level of sustainable sugarcane farming practices

The multiple regression analysis was undertaken to determine the extent of contribution of personal, behavioural, motivational, situational and extension factors on the adoption level of the sustainable sugarcane farming practices (Table XX).

A cursory look at the Table revealed that nearly 89 per cent of the variation in the adoption of sustainable farming practices in sugarcane could be explained by all the 30 independent variables included in the study. R^2 value of 0.8851 with significant 'F' value (26.57^{**}) revealed the significance at 1 per cent level of regression equation in the prediction of results.

It may be further observed from the Table that out of 30 variables, only five variables, namely, knowledge about sustainable sugarcane farming technologies (X_4), attitude towards sustainable farming (X_5), land productivity (X_{25}), farm scientist contact (X_{28}) and extension participation (X_{30}) were significant in multiple regression analysis in explaining the variation in the adoption of sustainable sugarcane farming practices.

TABLE XX

Contribution of personal, behavioural, motivational, situational and extension factors on the adoption level of sustainable sugarcane farming practices

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Groups	Selected factors	Regression coefficient	SE of regression coefficient	't' values
I Personal Factors				
X ₁	Age	-0.0509	0.1038	-0.49
X ₂	Education	0.2496	0.3134	0.79
X ₃	Socio-economic status	0.2486	0.2768	0.89
II Behavioural Factors				
X ₄	Knowledge about sustainable sugarcane farming technologies	2.2214	0.2066	10.75**
X ₅	Attitude towards sustainable farming	0.1611	0.0454	3.75**
III Motivational Factors				
X ₆	Management orientation	-0.1875	0.1865	-1.00
X ₇	Risk orientation	0.4565	0.3797	1.20
X ₈	Scientific orientation	-0.8598	0.2242	-3.83
X ₉	Economic motivation	-0.1526	0.3499	-0.43
X ₁₀	Value orientation	0.1071	0.2324	0.46
X ₁₁	Achievement orientation	-0.2735	0.1027	-2.66
X ₁₂	Level of aspiration	-0.1147	0.1165	-0.98
X ₁₃	Innovativeness	-0.2485	0.1643	-1.51
X ₁₄	Deferred gratification	0.0331	0.2566	0.12
X ₁₅	Cosmopolitaness	-0.2948	0.1529	-1.92
X ₁₆	Social participation	0.1935	0.1556	1.24
IV Situational Factors				
X ₁₇	Family size	0.1948	0.2097	0.92
X ₁₈	Farm size	0.5067	0.3217	1.57
X ₁₉	Sugarcane farming experience	0.1529	0.1057	1.44
X ₂₀	Herd size	-0.0372	0.0942	-0.39
X ₂₁	Self-reliance	0.0110	0.0176	0.62
X ₂₂	Input self-sufficiency	0.0803	0.0297	2.70
X ₂₃	Farm mechanization	-0.2470	0.1739	-1.42
X ₂₄	Farming commitment	0.0340	0.0659	0.51*
X ₂₅	Land productivity	0.1525	0.0522	2.91*
V Extension Factors				
X ₂₆	Mass media use	0.4399	0.1818	2.41
X ₂₇	Participation in training programme	-0.1624	0.1866	-0.87**
X ₂₈	Farm scientist contact	1.6093	0.3723	4.32**
X ₂₉	Extension agency contact	0.0777	0.0854	0.90*
X ₃₀	Extension participation	0.4872	0.1771	2.75*

* = Significant at 5 per cent level; ** = Significant at 1 per cent level

Rest of them are non-significant; SE = Standard Error; $R^2 = 0.8851$,
F = 26.57 (30,169)

4.4 Effect of personal, behavioural, motivational, situational and extension factors contributing to the adoption of sustainable sugarcane farming practices

For establishing a quantitative interpretation of direct, indirect and largest indirect effects of personal, behavioural, motivational, situational and extension factors on the adoption of sustainable sugarcane farming practices and for developing the operational statistical model, the path analysis which is an effective and appropriate technique was employed. For the purpose of path analysis, only 19 variables which were found to be significantly correlated with the adoption of sustainable sugarcane farming practices were accounted.

The details of the analysis comprising direct effect and total indirect effect and first, second and third largest indirect effects channelled through other variables on the adoption of sustainable sugarcane farming practices are presented in Table XXI.

A close observation of the Table implies that out of 19 variables selected for path analysis, 13 variables had positive direct effect and remaining six variables had negative, but direct effect on adoption of sustainable sugarcane farming practices.

Ranking variables based on their direct effect on adoption of sustainable sugarcane farming practices revealed

Effect of personal, behavioural, motivational, situational and extension factors contributing to the adoption of sustainable sugarcane farming practices

No.	Selected factors	Correlation co-efficient (r)	Direct effect	Rank	Total indirect effect	Rank	Three largest indirect effects channeled through
1	2	3	4	5	6	7	8
I Personal Factors							
X ₁	Age	0.2192 ^{**}	-0.045	18	0.291	8	0.122 X ₁₈ 0.085 X ₄ 0.025 X ₅
X ₂	Education	0.3616 ^{**}	-0.031	15	0.312	5	0.207 X ₄ 0.027 X ₅ 0.025 X ₂₃
X ₃	Socio-economic status	0.2141 ^{**}	0.031	11	0.278	11	0.182 X ₄ 0.035 X ₅ 0.030 X ₃₀
II Behavioural Factors							
X ₄	Knowledge about sustainable sugarcane farming technologies	0.8130 ^{**}	0.547	1	0.285	9	0.065 X ₅ 0.059 X ₃₀ 0.035 X ₂₁
X ₅	Attitude towards sustainable farming	0.5230 ^{**}	0.143	3	0.354	4	0.248 X ₄ 0.026 X ₂₆ 0.025 X ₃₀
III. Motivational Factors							
X ₉	Economic motivation	0.2746 ^{**}	-0.163	14	0.295	6	0.153 X ₄ 0.042 X ₂₈ 0.026 X ₁₈
X ₁₀	Achievement orientation	0.1476 [*]	-0.098	19	0.236	14	0.100 X ₄ 0.048 X ₂₈ 0.030 X ₅
X ₁₁	Level of aspiration	0.1461 [*]	-0.396	17	0.220	16	0.126 X ₄ 0.035 X ₅ 0.026 X ₂₃
IV. Situational Factors							
X ₁₈	Farm size	0.4411 ^{**}	0.067	9	0.386	1	0.258 X ₄ 0.041 X ₅ 0.030 X ₃₀

Table XXI contd..)

1	2	3	4	5	6	7	8
X ₁₉ Sugarcane farming experience		0.2456**	0.133	4	0.111	18	0.097 X ₄ 0.024 X ₅ 0.013 X ₂₁
X ₂₁ Self-reliance		0.1478**	0.022	12	0.097	19	0.059 X ₄ 0.021 X ₂₁ 0.019 X ₅
X ₂₂ Input self-sufficiency		0.4184**	0.100	7	0.359	3	0.191 X ₄ 0.038 X ₅ 0.019 X ₃₀
X ₂₄ Farming commitment		0.3167**	0.020	13	0.272	13	0.173 X ₄ 0.035 X ₃₀ 0.018 X ₂₆
X ₂₅ Land productivity		0.2403**	0.111	6	0.227	15	0.131 X ₄ 0.025 X ₅ 0.017 X ₃₀
V. Extension Factors							
X ₂₆ Mass media use		0.2923**	0.099	8	0.279	10	0.160 X ₄ 0.038 X ₅ 0.033 X ₂₈
X ₂₇ Participation in training programme		0.2508**	0.035	10	0.276	12	0.129 X ₄ 0.034 X ₂₈ 0.030 X ₅
X ₂₈ Farm scientist contact		0.1731*	0.170	2	0.118	17	0.094 X ₄ 0.019 X ₂₆ 0.014 X ₅
X ₂₉ Extension agency contact		0.2361**	-0.034	16	0.293	7	0.137 X ₄ 0.030 X ₂₆ 0.029 X ₅
X ₃₀ Extension participation		0.4889**	0.121	5	0.363	2	0.267 X ₄ 0.029 X ₅ 0.016 X ₁₇

Residual effect = 0.1222

* = Significant at 5 per cent level

** = Significant at 1 per cent level

that knowledge about sustainable sugarcane farming technologies (X_4), farm scientist contact (X_{28}), attitude towards sustainable farming (X_5), sugarcane farming experience (X_{19}), extension participation (X_{30}), land productivity (X_{25}), input self-sufficiency (X_{22}) and mass media use (X_{26}) occupied first eight ranks in that order, whereas education (X_2), extension agency contact (X_{29}), level of aspiration (X_{11}), age (X_1) and achievement orientation (X_{10}) obtained the last five ranks in the same order.

As regards to total indirect effects channeled through other variables for each of the independent variables, it was found quite substantial. Ranking of these effects revealed that farm size (X_{18}), extension participation (X_{30}), input self-sufficiency (X_{22}), attitude towards sustainable farming (X_5) and education (X_2) occupied the first five ranks which had the highest total indirect effect on adoption of sustainable sugarcane farming practices in the descending order of magnitude. On the other hand, land productivity (X_{25}), level of aspiration (X_{11}), farm scientist contact (X_{28}), sugarcane farming experience (X_{19}) and self-reliance (X_{21}) occupied the last five ranks in the same order.

The first largest indirect effect channeled through is knowledge about sustainable sugarcane farming technologies (X_4) in the case of seventeen variables and remaining two variables channeled through attitude towards sustainable

farming (X_5) and farm size (X_{18}). The second largest indirect effect channeled through attitude towards sustainable farming in case of nine variables closely followed by age (X_1) and mass media use (X_{26}). However, the third largest indirect effect has channeled through attitude towards sustainable farming (X_5). The total residual effect was found to be 0.1222. The data are diagrammatically presented in Fig. 6.

4.5 Discriminating the personal, behavioural, motivational, situational and extension factors for high and low adoption levels of sustainable sugarcane farming practices

Discriminant function analysis technique was employed to identify the personal, behavioural, motivational, situational and extension factors which would discriminate between high and low adopters of sustainable sugarcane farming practices and further to find out percentage contribution of individual independent variables to the total distance measured.

The results relating to the above analysis are presented in the Table XXII. The statistic value Mahalanobis ' D^2 ' and 'F' ratio calculated were 44.27 and 39.17, respectively. The F ratio was found to be significant at 1 per cent level. Hence, the distance between low and high adoption of sustainable sugarcane farming practices was significant. This implied that all the thirty independent

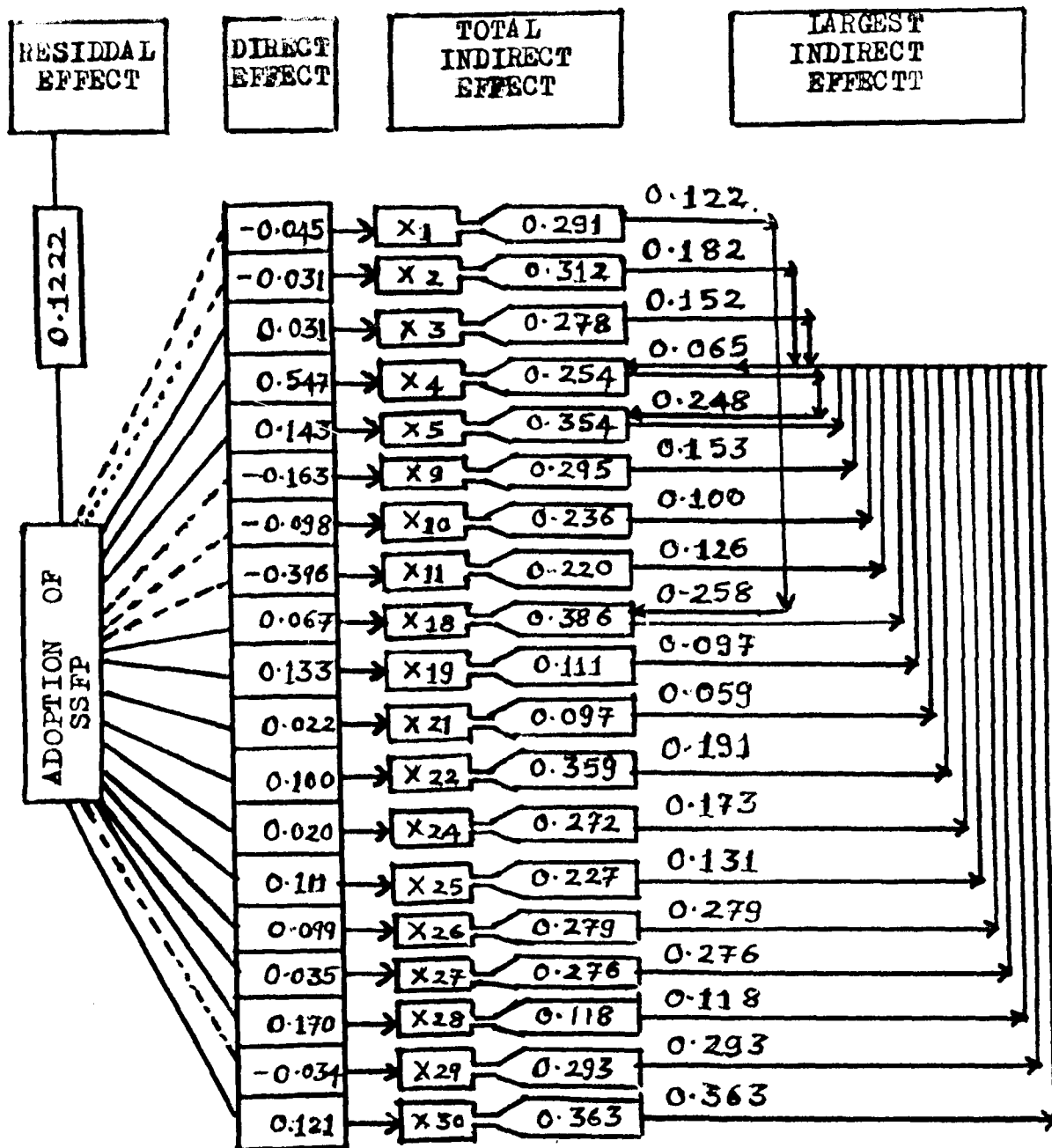


FIGURE 6: EFFECT OF FACTORS ON ADOPTION OF SUSTAINABLE SUGARCANE FARMING PRACTICES (SSFP)

Discriminating the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices

Sl. No.	Selected factors	Mean difference (di)	't' value	Discrimination function coefficient (Li)	di x Li	Percentage of the total	Rank
1	2	3	4	5	6	7	8
1.	Knowledge about sustainable sugarcane farming technologies (X ₄)	7.51	22.71**	2.63	19.75	44.61	1
2.	Farm size (X ₁₈)	2.56	8.82**	1.72	4.39	9.91	2
3.	Attitude towards sustainable farming (X ₅)	18.31	9.64**	0.21	3.92	8.85	3
4.	Extension participation (X ₃₀)	4.17	7.42**	0.80	3.33	7.53	4
5.	Mass media use (X ₂₆)	3.19	5.67**	0.74	2.35	5.32	5
6.	Input self-sufficiency (X ₂₂)	20.80	6.94**	0.09	1.96	4.44	6
7.	Education (X ₂)	1.88	6.83**	1.01	1.90	4.30	7
8.	Land productivity (X ₂₅)	8.84	4.58**	0.20	1.80	4.08	8
9.	Sugarcane farming experience (X ₁₉)	8.04	3.70**	0.18	1.47	3.33	9
10.	Farm scientist contact (X ₂₈)	1.01	3.48**	1.20	1.22	2.76	10
11.	Extension agency contact (X ₂₉)	5.86	4.99**	0.17	1.02	2.31	11
12.	Scientific orientation (X ₈)	0.81	2.03**	1.04	0.84	1.90	12
13.	Self-reliance (X ₂₁)	12.80	2.29*	0.03	0.42	0.94	13
14.	Farming commitment (X ₂₄)	6.31	3.96**	0.04	0.25	0.56	14
15.	Management orientation (X ₆)	0.54	1.05 ^{NS}	0.40	0.21	0.48	15
16.	Training (X ₂₇)	2.66	4.89**	0.08	0.21	0.46	16
17.	Value orientation (X ₁₀)	0.28	0.74 ^{NS}	0.60	0.17	0.39	17
18.	Risk orientation (X ₇)	0.19	0.75 ^{NS}	0.83	0.16	0.36	18
19.	Cosmopolitaness (X ₁₅)	0.62	1.03 ^{NS}	0.24	0.15	0.34	19
20.	Socio-economic status (X ₃)	0.26	2.72**	0.24	0.06	0.14	20
21.	Herd size (X ₂₀)	0.84	0.83 ^{NS}	0.07	0.06	0.13	21
22.	Social participation (X ₁₆)	0.26	0.42 ^{NS}	0.10	0.02	0.06	22

Table XXII contd..)

1	2	3	4	5	6	7	8
23. Deferred gratification (X_{14})	0.32	0.85 ^{NS}	0.04	0.01	0.03	23	
24. Family size (X_{17})	0.39	0.79 ^{NS}	0.01	0.00	0.01	24	
25. Innovativeness (X_{13})	1.60	2.41 [*]	0.00	-0.01	-0.01	25	
26. Farm mechanization (X_{23})	0.01	0.02 ^{NS}	0.78	-0.01	-0.02	26	
27. Age (X_1)	7.64	3.36 ^{**}	0.01	-0.04	-0.10	27	
28. Achievement orientation (X_{11})	2.60	2.73 ^{**}	0.12	-0.32	-0.72	28	
29. Level of aspiration (X_{12})	1.75	2.01 [*]	0.26	-0.46	-1.04	29	
30. Economic motivation (X_9)	1.09	4.24 ^{**}	0.54	0.59	-1.32	30	

* = Significant at 5 per cent level; ** = Significant at 1 per cent level
 NS = Non-significant; $D^2 = 44.27$, $F = 39.17^{**}$ (30,105)

variables together were useful in discriminating the farmers with low and high adoption levels of sustainable sugarcane farming practices.

The mean difference (d_i), coefficients of discriminant function (l_i), product ($d_i \times l_i$) and percentage derived from the analysis are presented in the Table XXII. Among the mean differences (d_i) obtained over thirty variables, the statistical significance were found in the case of 21 variables.

Level of aspiration (X_{12}), innovativeness (X_{13}) and self-reliance (X_{21}) had significant relationship at 5 per cent level, while age (X_1), education (X_2), socio-economic status (X_3), knowledge about sustainable sugarcane farming technologies (X_4), attitude towards sustainable farming (X_5), scientific orientation (X_8), economic motivation (X_9), achievement orientation (X_{11}), farm size (X_{18}), sugarcane farming experiences (X_{18}), input self-sufficiency (X_{22}), farming commitment (X_{24}), land productivity (X_{25}), mass media use (X_{26}), training (X_{27}), farm scientist contact (X_{28}), extension agency contact (X_{29}) and extension participation (X_{30}) had highly significant relationship (1 per cent level) with the adoption level of sustainable sugarcane farming practices.

It can be seen from the Table that ranking of percentages of distance measured by important variables

revealed that first seven ranks comprising knowledge about sustainable sugarcane farming technologies (44.61 per cent), farm size (9.91 per cent), attitude towards sustainable farming (8.85 per cent), extension participation (7.53 per cent), mass media use (5.32 per cent), input self-sufficiency (4.44 per cent) and education (4.30 per cent) were found to be contributing more as compared to other variables in discriminating the farmers with low and high adoption levels of sustainable sugarcane farming practices (Fig. 7).

The calculated discriminant scores ' Z_1 ' and ' Z_2 ' for low and high adopters of sustainable sugarcane farming practices were 85.72 and 127.74, respectively. The critical value of discriminant scores (Z) for these two groups was 62.51.

4.6 Components contributing to adoption sustainable sugarcane farming as perceived by farmers

It could be observed from the Table XXIII that the most important components contributing to sustainable sugarcane farming as perceived by farmers are application of farm yard manure/compost (99 per cent), application of biofertilizers (85 per cent), adoption of hot water treatment of setts to prevent disease (78.5 per cent), proper water management practices before, during and after fertilizer application (74.5 per cent), non-dependency on chemical

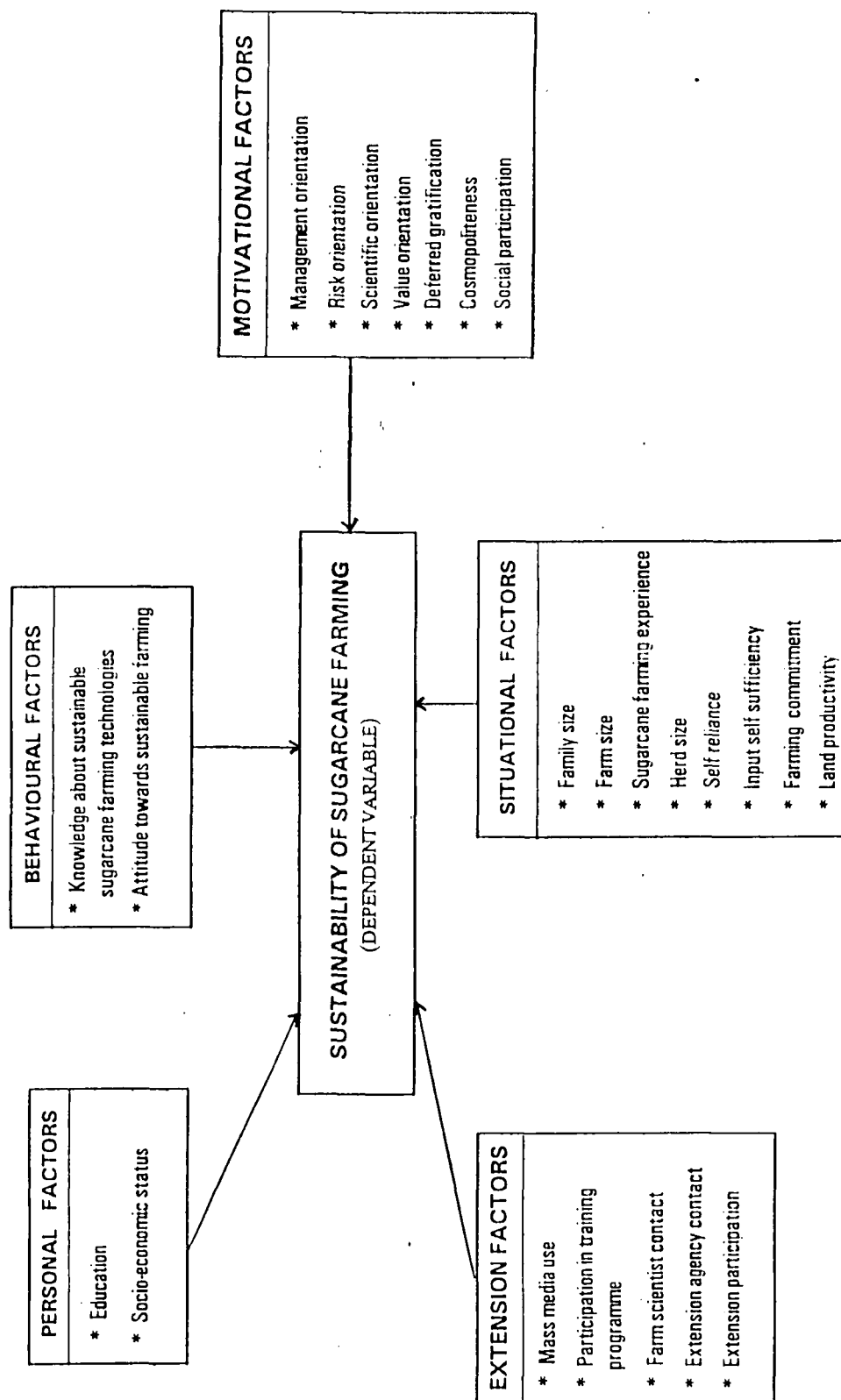


FIGURE 7 : FACTORS DISCRIMINATING THE SUSTAINABILITY OF SUGARCANE FARMING

TABLE XXIII

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Components contributing to sustainable sugarcane as
perceived by farmers

(n = 200)

Sl. No.	Components [*]	Sugarcane farmers	
		Number	Per cent
1.	Application of farm yard manure/compost	198	99.0
2.	Use of biofertilizers	170	85.0
3.	Adoption of hot water treatment of setts to prevent diseases	157	78.5
4.	Proper water management practices before, during and after fertilizer application	149	74.5
5.	Non-dependency on chemical pesticides	141	70.5
6.	Good knowledge on sustainable sugarcane farming practices	132	66.0
7.	Adoption of intercropping in sugarcane	126	63.0
8.	Availability of technical guidance from extension workers on sustainable sugar- cane farming practices	125	62.5
9.	Balanced use of fertilizers	109	54.5
10.	Non-dependency on farm power	107	53.5
11.	Application of press mud	104	52.0
12.	Release of <u>Trichogramma</u> egg parasites to control early shoot borer	100	50.0
13.	Adoption of salt tolerant sugarcane variety (Co-62175)	70	35.0
14.	Adoption of green leaf manure	69	34.5
15.	Adoption of crop rotation	29	14.5
16.	Application of micronutrients	21	10.5
17.	Application of soil amendments	12	6.0
18.	Application of crop residues (cane stubbles and leaf trash)	2	1.0

* = Multiple responses are possible

pesticides (70.5 per cent), good knowledge on sustainable sugarcane farming practices (66 per cent), adoption of intercropping (63 per cent), availability of technical guidance from extension workers on sustainable sugarcane farming practices (62.5 per cent), balanced use of fertilizers (54.5 per cent), non-dependcy on farm power (53.5 per cent) and application of press mud (52 per cent).

The next important component contributing to sustainable sugarcane farming is the release of *Trichogramma* egg parasites to control early shoot borer as expressed by half (50 per cent) of the sugarcane farmers.

The least important components contributing towards sustainable sugarcane farming as perceived by farmers are adoption of salt tolerant variety of sugarcane (35 per cent), application of green leaf manures (34.5 per cent), adoption of crop rotation (14.5 per cent), application of micronutrients (10.5 per cent), application of soil amendments (6 per cent) and application of crop residues (1 per cent).

DISCUSSION

2

CHAPTER V

DISCUSSION

The discussion of the results of the study are presented under the below mentioned subheads. Since the research studies in this particular field were very scarce, the findings of the related studies were made use of substantiate the results, wherever possible.

- 5.1 Adoption of sustainable sugarcane farming practices by farmers
- 5.2 Relationship and contribution of personal, behavioural, motivational, situational and extension factors (independent variables) on the adoption level of sustainable sugarcane farming practices
- 5.3 Effect of personal, behavioural, motivational, situational and extension factors contributing to the adoption of sustainable sugarcane farming practices
- 5.4 Discriminating the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices
- 5.5 Components contributing to sustainable sugarcane farming as perceived by farmers.

5.1 Adoption of sustainable sugarcane farming practices by farmers

This section deals with the extent of adoption of specific sustainable sugarcane farming practices and the adoption pattern of such practices by farmers with respect to each of the eight components of sustainable sugarcane farming practices, namely, land preparation, seeds (setts) and

sowing, sugarcane based cropping system, integrated nutrient management, water management, integrated pest management, ratoon management, and maturity and harvesting.

This section also deals with the overall adoption pattern of sustainable sugarcane farming practices by farmers.

5.1.1 Land preparation

5.1.1.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Land preparation

It is observed from Table II that majority (53.5 per cent) of the sustainable sugarcane farmers had ploughed the land using bullock power, which means that the farmers were aware of the fact that in sustainable agriculture there is no need for deep ploughing of land using tractor/power tiller which disturbs the soil structure resulting in soil compactness. Use of tractor/power tiller involves using fossil fuel which amounts to external input, this goes against the principle of sustainable agriculture. This finding agrees with the findings of Ramesh and Jayaramaiah (1996).

About 46.5 per cent of the sugarcane farmers had used tractor/power tiller to plough their land. The reason for using machines in ploughing was that they wanted to remove the roots of the previous sugarcane crop which were lying

deep in the soil and also to provide easy penetration of roots of the succeeding sugarcane crop. This implies, that still a large chunk of the sugarcane farmers think that the roots and stubbles of previous sugarcane crop need to be removed and not to be buried in the soil for decomposition. This is against the principle of sustainable farming, the roots and stubbles left over in sugarcane fields would decompose i.e., they get recycled and add organic manure for sustaining the succeeding crop. This fact should be made known to the farmers. Training, demonstrations, distribution of literature on recycling of farm wastes supported by field visits, farm and home visits will go a long way in convincing the farmers about these aspects.

It was also observed that all the sustainable sugarcane farmers had prepared the land into ridges and furrows for planting setts. Preparing the land into ridges and furrows is an essential operation for crop establishment and to follow effective cultural practices like water and fertilizer management, intercultivation practices, etc.

5.1.1.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Land preparation

Table III reveals that majority (53.5 per cent) of the sustainable sugarcane farmers belonged to high adoption level in respect of land preparation, while 46.5 per cent of the farmers were found to be low adopters of land preparation practices.

Majority (53.5 per cent) of the sustainable sugarcane farmers who belonged to high adoption level of land preparation practices had prepared the land into ridges and furrows to plant setts. Further, these farmers had used bullocks to plough their lands. About 46.5 per cent of the farmers who belonged to low adoption level of land preparation practices had used tractor/power tiller to plough their lands, which is against the principle of sustainable agriculture.

5.1.2 Seeds (setts) and sowing

5.1.2.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Seeds (setts) and sowing

Table IV reveals that cent per cent sustainable sugarcane farmers had used the recommended quantity of setts for planting. Majority of the sugarcane farmers had selected setts from main (first) crop for planting (91 per cent), selected setts with 2-3 eye buds (82 per cent), used setts of correct age for planting (80 per cent), selected top internodes as setts in the case of old and overmatured crop (66 per cent) and adopted recommended spacing (61 per cent). These findings are similar to the findings of Aswathiah et al. (1975), Rotti (1983), Mahadeviah (1987), Patel et al. (1983) and Wasnik (1993).

Possibly the adoption of the above sustainable practices by majority of the sugarcane farmers might be due

to the fact that they are simple, require no cash or low cost practices. In other words, simpler practices and practices which require no cash or low cost are adopted easier by the farmers.

In order to promote sustainable agriculture, it is necessary to develop technology which requires less cost or no cost. External inputs which are to be purchased at high cost in the market are usually not adopted by the farmers following sustainable agriculture.

Singh et al. (1990) termed sustainable agriculture as low input agriculture. Adoption of non-cash and low cost technologies result in the reduction of production costs, thereby, lowering per unit expenditure on production of a unit of output.

5.1.2.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Seeds (setts) and sowing

It is observed from Table V that 44.5 and 29.5 per cent of the sustainable sugarcane farmers were found to be in medium and high adoption levels of seeds (setts) and sowing practices, respectively. While, 26 per cent of them belonged to low adoption level. It could be inferred that as high as 74 per cent of the sugarcane farmers were found to be in high/medium adoption levels of seeds (setts) and sowing practices. The possible reason for majority of the farmers

belonging to high/medium adoption categories might be due to adoption of simple practices, non-cash and low cost practices, easy availability of setts from Sugarfactories and technical guidance from extension workers.

5.1.3 Sugarcane based cropping system

5.1.3.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Sugarcane based cropping system

It is evident from Table VI that vast majority of over 80 per cent of the sustainable sugarcane farmers were not practicing crop rotation in sugarcane. The possible reason for majority of the sugarcane farmers for not practicing crop rotation are: (i) Ragi is not a profitable crop when rotated with sugarcane, and (ii) legumes cannot be grown earlier to sugarcane because of inundation of water in land (which is also not profitable). Hence, majority of the sustainable sugarcane farmers had not practised crop rotation either with legume or with ragi in sugarcane crop.

Crop rotation with legume and ragi were found to add considerable amount of organic matter to soil (Sundara et al., 1996). Legume, when used as rotational crop, fixes atmospheric nitrogen and saves upto 25 per cent of nitrogen recommended (Ahlawat, 1996).

The results also indicate that majority (63 per cent) of the sustainable sugarcane farmers had grown legume as an

intercrop in sugarcane crop. This finding is in line with the findings of Shankaraiah et al. (1996a).

It is very interesting to note that sugarcane farmers have preferred to grow legumes as an intercrop rather than growing it as a rotational crop. Farmers seem to have realized and are convinced about the benefits of intercropping of legumes in sugarcane as it not only improves soil fertility but also provides additional income.

5.1.3.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Sugarcane based cropping system

The results in Table VII reveal that 53 and 34.5 per cent of the sustainable sugarcane growers belong to medium and low adoption levels of sugarcane based cropping system practices, respectively. About 12.5 per cent of them fell under high adoption level. It could be concluded that as high as 87.5 per cent of the sugarcane farmers belong to low/medium adoption levels of sugarcane based cropping system practices. The possible reason for a vast majority of the sugarcane farmers belonging to low/medium adopters is due to poor adoption of crop rotation practices in sugarcane crop.

5.1.4 Integrated nutrient management

5.1.4.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated nutrient management

This section deals with the extent of adoption of soil testing, organic manures, inorganic manure (fertilizers),

micronutrients and soil amendments by sustainable sugarcane farmers.

5.1.4.1.1 Soil test

The results in Table VIII indicate that only five per cent of the sugarcane farmers had tested the soil before planting the main (first) crop, while a vast majority (95 per cent) of them had not tested the soil.

Lack of awareness of the benefits of soil testing is the main reason for a vast majority of sugarcane farmers for not testing the soil before planting the main (first) crop. Based on the soil test results, the fertility status of the soil will be known. With the help of the soil test results, one can correct the nutrient deficiency in soil and also it helps to neutralize the soil (if the soil is experiencing acidity/alkalinity) by the application of the soil amendments to get better and sustained yields.

Demonstrations on the procedure of drawing soil samples for soil testing and field visits to soil tested fields would educate and convince the farmers about the beneficial effects of soil tests. Department of Agriculture, Sugarfactories and Agricultural Research Stations should extend facilities to the farmers in providing mobile soil testing laboratory which helps the farmers to test their soils regularly at their door steps.

5.1.4.1.2 Application of organic manure

5.1.4.1.2.1 Application of farm yard manure/compost : The results in Table VIII show that 46 per cent of the sustainable sugarcane farmers had adopted the recommended quantity of farm yard manure/compost. This implied that these farmers were aware of the advantages of the application of farm yard manure/compost to the soil. The fact that the application of farm yard manure/compost is a simple technology, involves less cost, ensures uniform maturity of crops, gives higher yields and improves soil fertility as reported by Muthuraman (1995b) is well understood by the full adopters of this practice.

One per cent of the sugarcane farmers had not applied farm yard manure/compost to sugarcane crop, while more than half (53 per cent) of farmers had applied less than the recommended quantity. Shortage and non-availability of farm yard manure/compost are the reasons for non-application and partial application of recommended quantity of farm yard manure/compost.

The Table also reveals that vast majority of over 80 per cent of the sugarcane farmers had followed the correct time and method of application of farm yard manure/compost to sugarcane crop. All the farmers who had used farm yard manure/compost had distributed it to the plots equally.

The results clearly imply that the sugarcane farmers adopted all other related practices except the recommended quantity of farm yard manure/compost. The non-availability of farm yard manure/compost has worked as a constraint for not applying the recommended quantity. In view of degraded forests and scarcity for fodder the farmers are unable to keep more livestock and thereby the production of farm yard manure is limited. Also, the farmers are not conscious about recycling the farm wastes, especially the sugarcane trash and farm wastes can be conveniently converted into a valuable compost. Therefore, extension agencies need to educate farmers in this regard.

5.1.4.1.2.2 Application of green leaf manure : It is observed from Table VIII that nearly two-thirds (65.5 per cent) of the sustainable sugarcane farmers had not applied green leaf manure to sugarcane crop. Lack of knowledge on the potentialities of green manure crops and non-availability of green leaf manure are the reasons for nearly two-thirds of the sugarcane farmers in not adopting green manuring in sugarcane crop. Hence, the extension workers need to educate the sugarcane farmers about the beneficial effects of the green manures by conducting result demonstration on farmers' field. Green manures add organic matter to the soil and act as a good amendment in the case of problematic soil.

5.1.4.1.2.3 Application of biofertilizers (Azotobacter/Azospirillum) : It is revealed from Table VIII that a vast majority (85 per cent) of the sustainable sugarcane farmers had applied biofertilizers to sugarcane crop. The Karnataka State Department of Agriculture had supplied biofertilizers free of cost to farmers to popularize the use of it. Hence, majority of the farmers took advantage of this facility and applied biofertilizers to their sugarcane crop.

It is interesting to note that among the users of biofertilizers, majority (69 per cent) of them had partially adopted the recommended quantity of biofertilizers. They had applied it only once to sugarcane crop while, it is recommended to be applied twice. This is because, the Karnataka State Department of Agriculture had supplied only one kilogram of biofertilizers free to all the farmers to popularize it. The farmers had applied this packet at the time of planting setts and kept quite. The second dose of biofertilizers (which needs to be applied after 30 days of planting setts) was not purchased and applied to the crop by the farmers.

It is also observed that majority (63 per cent) of the sugarcane farmers who had applied biofertilizers, had not followed the right method of application. This is because of lack of knowledge and negligent use of biofertilizers by the farmers, since it was given free.

All the farmers who had used biofertilizers had distributed it to the sugarcane plots equally.

Incidentally, the farmers had applied biofertilizers to sugarcane crop since it was given free of cost. Real education has not taken place among the farmers regarding the use of biofertilizers. Sugarfactories, Department of Agriculture and Agricultural Research Stations can play a dominant role in educating the farmers about the method of application and effective use of biofertilizers in sugarcane crop.

5.1.4.1.2.4 Application of crop residues (cane stubbles and leaf trash) : It is observed that almost all the sustainable sugarcane farmers (99 per cent) did not apply crop residues to sugarcane crop. This might be due to lack of awareness and knowledge about the benefits of incorporation of crop residues. The farmers perceive that burning the crop residues makes the field free from pests and diseases, and also they perceive that burning of crop residues facilitates easy land preparation and intercultivation practices for succeeding crop. However, the above findings are not in conformity with the findings of Ramaswamy (1996) and Ramesh and Jayaramaiah (1996) who concluded that the crop residue management through mulching and composting improves soil fertility, soil health and yield of crops.

Crop residue in irrigated area is easily decomposable adding large quantity of organic matter to the soil. Hence, it can be easily recycled in irrigated areas to get plant nutrients. Farmers' attitude on burning the crop residues needs to be changed. Actual demonstrations on how to incorporate crop residues in sugarcane fields would educate the farmers in using it effectively and efficiently.

5.1.4.1.2.5 Application of press mud : It is found that 51 per cent of the sustainable sugarcane farmers had applied less than the recommended quantity of press mud, while 48 per cent had applied the recommended quantity. Only one per cent of the sugarcane farmers did not apply press mud. Non-availability of press mud in Sugarfactories is the main reason for majority of sugarcane farmers for not adopting or partially adopting the recommended quantity of press mud to sugarcane crop.

5.1.4.1.3 Application of inorganic manure (fertilizers) : The results in Table VIII indicate that majority (54.5 per cent) of the sustainable sugarcane farmers had completely adopted the recommended quantity of fertilizers. Since sugarcane being an exhaustive cash crop, majority of the farmers had adopted the recommended quantity of fertilizers which has an impact on yield by supplying the major plant nutrients like nitrogen, phosphorus and potash. It is interesting to note that as many as 45.5 per cent of the

sugarcane farmers had applied less than the recommended quantity of fertilizers. Lack of knowledge on the recommended fertilizer dosage and expensiveness of fertilizers might have resulted in such a situation.

Majority of the sustainable sugarcane farmers had completely adopted the recommended quantity of nitrogenous (90.5 per cent), phosphorus (54.5 per cent) and potash (69 per cent) fertilizers. Due to decontrol of nitrogenous fertilizers by the government, nitrogenous fertilizers particularly urea has become cheaper, when compared to phosphorus and potash. Hence, there is more use of nitrogenous fertilizers by farmers compared to the use of phosphorus and potash fertilizers which are relatively expensive. This could be the reason for large number of farmers using more of nitrogenous fertilizers in sugarcane compared to phosphorus and potash fertilizers.

It is also observed that cent per cent sugarcane farmers had applied NPK as basal dose at the time of planting setts as recommended. All the sugarcane farmers had applied nitrogenous fertilizers as first top dressing, while 85.5 and 54.5 per cent of the sugarcane farmers had applied nitrogenous fertilizers as second and third top dressing, respectively. The reasons for majority of the farmers adopting above mentioned practices might be due to the fact that the sugarcane farmers have been properly informed and

educated by the extension workers (about the importance of such practices). Hence, majority of the farmers had followed it.

Majority of the farmers (54.5 per cent) have adopted fertilizers to sugarcane crop as recommended by the scientists. This clearly indicates that majority of the sustainable sugarcane farmers have clearly understood the role of balanced plant nutrients, namely, NPK. Apart from this, a sizeable number of sugarcane farmers (45.5 per cent) had used partial dose of recommended fertilizers which implies that these farmers have not balanced their fertilizer use. Balanced nutrient management is one of the essential components of sustainable farming. It is, therefore, very necessary that the sugarcane farmers are to be educated for using balanced fertilizers through demonstrations, trainings and discussion meetings, etc. The Department of Agriculture, Agricultural Research Stations and Sugarfactories have to play a key role in this direction.

5.1.4.1.4 Application of micronutrients (only iron deficiency was noticed in sugarcane) : It is observed from Table VIII that a vast majority (76.5 per cent) of sustainable sugarcane farmers did not notice iron deficiency in their soil, while only 23.5 per cent of them met with iron deficiency. Among the farmers who had iron deficiency in their soils, about 45 per cent of them could take up remedial measures by applying

ferrous sulphate to overcome iron deficiency and the remaining 55 per cent of the farmers did not apply ferrous sulphate to overcome iron deficiency.

The probable reason for this kind of a situation might be that few farmers who had access to the Agricultural Department, could get the input (ferrous sulphate) free of cost and apply it to their fields. Others did not apply, because, it was not easily available to them. This kind of trial and error method of diagnosing and helping the farmers will not result in real extension education. What is required is that, the farmers should be educated to diagnose the iron deficiency in their soils/lands on their own and overcoming the deficiency by voluntarily purchasing the required input (ferrous sulphate) and applying it. As otherwise, farmers will not adopt the technology and the trial and error method of working with them will never bring real education among the farmers.

5.1.4.1.5 Application of soil amendments (gypsum/lime) : Majority (52.5 per cent) of the sustainable sugarcane farmers did not have their soil affected by salts, while 47.5 per cent of the farmers had the problem of salt in their soil (Table VIII). Among the farmers who had the problem of salt in their soils, about 74 per cent of the sugarcane farmers had grown salt tolerant sugarcane variety (Co-62175) ,and 12.5 per cent of them had applied soil amendments to tackle

the problem of salts. Only 13.5 per cent of the farmers did not take up any measures to combat the salt problem.

Frequent contacts with farm scientist and extension workers, and regular participation in the extension activities like discussions, field days, demonstrations, etc., has helped the farmers to know about the existence and performance of salt tolerant variety. Hence, a vast majority (74 per cent) of the sugarcane farmers have adopted the salt resistant sugarcane variety (Co-62175) to combat salts in soil.

5.1.4.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Integrated nutrient management

The results of Table IX indicate that 37.5 per cent of the sustainable sugarcane farmers were found to be in low adoption level of integrated nutrient management practices. On the contrary, 33 and 29.5 per cent of the farmers belonged to high and medium levels of adoption of integrated nutrient management practices, respectively. It can be concluded that as high as 62.5 per cent of the farmers belong to high/medium levels of adoption of integrated nutrient management practices.

The possible reasons for majority (62.5 per cent) of the sustainable sugarcane farmers belonging to high/medium levels of adoption of integrated nutrient management practices are due to the fact that the sugarcane farmers

might have understood the value of organic manures (farm yard manure/compost, biofertilizers, press mud, etc.) and inorganic manure (fertilizers) in their proper combinations and have adopted these practices.

Although sugarcane farmers were aware of both organic and inorganic manures (which constitutes integrated nutrient management), still some of them did not adopt it. Hence, both the farm scientists and extension workers should educate the farmers about the benefits in using them, and encourage them to use more of organic manures, balanced use of fertilizers, micronutrients and soil amendments which result in increased soil fertility to get better and sustained yields.

Integrated nutrient management is one of the important components of sustainable agriculture to get better and sustained yields. Important subcomponents of integrated nutrient supply system are organic manures, fertilizers, agro-industrial wastes, crop residues, biofertilizers, green manures and legumes in cropping system. The above results is supported by that of Surekha and Rao (1995).

5.1.5 Water management

5.1.5.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Water management

5.1.5.1.1 Frequency and method of irrigation : It is found from Table X that majority (75.5 per cent) of the

sustainable sugarcane farmers had irrigated sugarcane crop grown in red soils once in 5-8 days. The possible reason is that majority of the farmers were aware of the schedule of irrigation in red soils by their experience. All the farmers had realized that furrow method of irrigation was the best method to irrigate sugarcane, hence they had adopted.

5.1.5.1.2 Water management practices for soils affected by salts : It is also observed from Table X that majority (52.5 per cent) of the sustainable sugarcane farmers did not have their soil affected by salts, while 47.5 per cent of farmers had the problem of salt in their lands. All the farmers whose soils were affected by salts were aware of the solutions to overcome salt problem. Hence, they had changed the salt affected water with fresh water frequently. About 74 per cent of the farmers had also taken precautionary measures by growing salt tolerant sugarcane variety (Co-62175) to tackle the problem of salt.

5.1.5.1.3 Water management practices under water shortage/ deficit condition : It is observed from Table X that as high as 55.5 per cent of the sugarcane farmers had the problem of water deficit/shortage condition which adversely affect the yield. About 44.5 per cent of the farmers experienced no such problem. Probably, the topography of the land plays an important part in the availability of water to sugarcane crop. The low lying lands in the valley will have no problem

of water deficiency, while the land situated in the ridges would face the problem of water shortage. Naturally, the yields in the water deficit ridge land will be lower. It is, therefore, suggested that the Sugar factories and the Government have to help the sugarcane farmers by providing lift irrigation facilities for upper reach farmers.

Among the farmers who experienced water shortage during the cane cultivation, vast majority (91.5 per cent) of them did not take up measures to conserve moisture. This indicates that the farmers need to be educated on the important sustainable practices to conserve moisture. Mulching sugarcane crop with leaf trash helps in preventing the loss of water through evaporation, thus saving 50 per cent of irrigation water (Nagarajan, 1992). It is, therefore, necessary that intensive educational efforts need to be undertaken to convince the farmers about the benefits of mulching in sugarcane crop.

5.1.5.1.4 Water management practices under excess water/ water logged condition : The results in Table X also revealed that among the sugarcane farmers who had no water shortage i.e., 44.5 per cent of them expressed water logged condition in sugarcane fields. Among these farmers all of them had provided diversion drains to drain out excess water, while 78.5 per cent had grown salt tolerant sugarcane variety (Co-62175) to thwart the problem of excess water/ water logged condition.

5.1.5.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Water management

The results in Table XI indicates that 39 per cent of the sustainable sugarcane farmers were found to be in low level of adoption of water management practices, while 37 and 24 per cent were belonging to high and medium adoption levels of water management practices, respectively. It can be inferred that as high as 61 per cent of the farmers belonged to high/medium levels of adoption of water management practices.

The reasons for majority (61 per cent) of the sustainable sugarcane farmers belonging to high/medium levels of adoption of water management practices may be attributed to the fact that frequent contact of farmers with the farm scientist and extension workers, and the experience gained by farmers in cane cultivation might have led to farmers to adopt the water management practices to combat excess salt and water logged condition in sugarcane fields.

Water is an important input. Hence, its utilization and management are important to get better crop production and productivity. Effectiveness in water saving, equity in water sharing, efficiency in water delivery and use are important for sustainable use of available surface and ground water resources. Over irrigation and its bad impacts on physical, chemical and biological properties of soil can be

checked when water is used efficiently and economically (Muthuraman, 1995).

5.1.6 Integrated pest management

5.1.6.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated pest management

This section consists of the extent of adoption of integrated weed management, integrated disease management and integrated pest management practices followed by sugarcane farmers.

5.1.6.1.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated weed management

It is observed from Table XII that all the sustainable sugarcane farmers had the problem of weeds in sugarcane crop. Majority (50.5 per cent) of the farmers controlled it by hand weeding, while 30 and 19.5 per cent of them controlled weeds by intercultural operations and by using herbicides, respectively.

Sugarcane farmers have realized the harmful effects of the use of herbicides which affect the soil health. Hence, majority of them had controlled the weeds by hand weeding and by intercultural operations. Probably, due to shortage of labour to remove the weeds 19.5 per cent of the sustainable sugarcane farmers had used herbicides.

5.1.6.1.2 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated disease management

The results in Table XII revealed that all the sugarcane farmers had used disease free seed (setts) material for planting. Majority of them (78.5 per cent) had treated the setts with hot water. The yellow clumps were uprooted and burnt by 33.5 per cent of the sugarcane farmers.

Disease free seed (setts) were provided by the Regional Agricultural Research Station (Mandya) through Sugar factories. Hence, all the sugarcane farmers had used it. Majority (78.5 per cent) of the farmers seemed to have been educated by extension workers about the importance of hot water treatment to setts and the farmers adopted it. By experience one can identify the symptoms of grassy shoot of sugarcane disease and 33.5 per cent of the farmers who had the problem (yellowingness of the clumps) had removed and burnt it.

It can also be seen from the results that majority (64 per cent) of the sustainable sugarcane farmers had the problem of brown leaf spot disease on sugarcane crop, while 36 per cent of them had no such problem.

Among the farmers who had the problem of brown leaf spot disease on sugarcane crop, majority (61 per cent) had provided good drainage and 5.5 per cent of the farmers had

applied 25 per cent excess potash fertilizers to control the disease. About 33.5 per cent of the farmers did not take any control measures against brown leaf spot disease.

This suggests that extension workers should motivate the sugarcane farmers to take control measures against brown leaf spot disease. The farmers need to be educated on the identification and control of the disease, otherwise, the yields are going to be reduced putting the farmers in a very disadvantageous position.

5.1.6.1.3 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated insect management

The data in Table XII reveal that majority (73 per cent) of the sustainable sugarcane farmers did not have the termite problem in sugarcane crop, while only 27 per cent of them had such problem. About 63 per cent of the sugarcane farmers who had the termite problem on sugarcane crop were aware of the fact that termites could be controlled by providing frequent irrigation to the crop.

The results further revealed that majority (58.5 per cent) of the sustainable sugarcane farmers had the problem of early shoot borer on sugarcane crop, while 41.5 per cent of them did not have such problem.

All the farmers who had the problem of early shoot borer were aware of how to control it. Out of this, a vast

majority (85.5 per cent) of the sugarcane farmers had adopted the biological control measures (release of *Trichogramma* egg parasites) to control the early shoot borer on sugarcane crop, while 12.5 and 2 per cent of them had followed earthening up operation and practised mulching, respectively.

Among the farmers who had released *Trichogramma* egg parasites to control early shoot borer in sugarcane crop, majority (51 per cent) of them had released it in five batches which is less than the recommended number of batches to be released. Only 49 per cent of the farmers had released the egg parasites in five batches as recommended. Majority (60 per cent) of the farmers had released the egg parasites at an inappropriate time.

Although there is a *Trichogramma* parasitic laboratory located at Mandya for the benefit of sugarcane farmers, the farmers are not taking full advantage of this laboratory as it is evident from the fact that majority (51 per cent) of the farmers could not release the egg parasites in five batches as recommended.

The extension workers should supervise the availability of *Trichogramma* egg parasites and see that the farmers have easy accessibility and ready availability in time to control the early shoot borer on sugarcane crop. It is also necessary that the farmers need to be convinced about the

release of *Trichogramma* egg parasites for controlling the early shoot borer in sugarcane. This could be done by making use of a combination of extension methods such as farm and home visits, demonstrations coupled with mass media for greater utilization of this technology by the sugarcane farmers.

5.1.6.2 Adoption pattern of adoption of sustainable sugarcane farming practices by farmers in respect of Integrated pest management

The results in Table XIII indicate that 35 per cent of the sugarcane farmers were found to be in low level of adoption of integrated pest management practices, while 34 and 31 per cent of the farmers belonged to medium and high levels of adoption of integrated pest management practices, respectively. It can be inferred that as high as 65 per cent of the farmers fall under high/medium levels of integrated pest management practices.

The reasons for majority (65 per cent) of the sustainable sugarcane farmers belonging to high/medium adoption levels of integrated pest management practices might be due to the fact that these farmers have been educated by the extension agencies regarding the adoption of disease free seed (setts), hot water treatment of setts, uprooting and burning of virus affected yellow clumps, frequent irrigation and provision of good drainage. These farming practices are ecofriendly, simpler and safer pest control measures. This finding is supported by the findings of Muthuraman (1996a).

5.1.7 Ratoon management

5.1.7.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Ratoon management

The results in Table XIV reveal that majority (68 per cent) of the sustainable sugarcane farmers had practised ratoon at the right time. Cent per cent sugarcane farmers had performed gap filling operations. Majority (91 per cent) of the farmers had performed shoulder breaking operation, while 85.5 per cent of them had performed stubble shaving operations in ratoon sugarcane crop. These operations are very essential and time bound. Hence, majority of the sugarcane farmers had performed these operations.

Only one per cent of the sugarcane farmers had used leaf trash as a mulch to ratoon crop. This is because, large majority of the farmers had the habit of burning the leaf trash in the field. Therefore, the extension worker should conduct demonstrations in farmers' fields on the use of leaf trash as mulches. Mulching leaf trash in sugarcane helps in controlling weeds, reduces evaporation of water and adds nutrients (Nagarajan, 1992).

Farm yard manure/compost was used by majority (92.5 per cent) of the sugarcane farmers in case of ratoon crop, while only 7.5 per cent of them had not applied it to ratoon sugarcane crop. Majority (72.5 per cent) of the sugarcane

farmers had applied partial quantity of recommended farm yard manure/compost to ratoon. Shortage and non-availability of farm yard manure/compost were the reasons for majority of the farmers applying partial quantity of recommended farm yard manure/compost to ratoon crop.

Fertilizers were applied by a vast majority (95 per cent) of the sugarcane farmers to ratoon crop, while only five per cent of them did not apply it to ratoon sugarcane crop. The recommended quantity of fertilizers was applied by 43.5 per cent of the sugarcane farmers, while majority (51.5 per cent) of them had applied partial quantity of recommended fertilizers to ratoon sugarcane crop.

The reasons for majority of sugarcane farmers applying partial quantity of the recommended dose of fertilizers to ratoon sugarcane crop is due to the lack of adequate knowledge and lack of technical guidance on the recommended quantity of fertilizers the ratoon sugarcane crop needs. Ratoon sugarcane crop needs the same quantity of fertilizers as that of the main (first) crop and hence it is essential to apply the same to the ratoon crop also.

Among the farmers who had applied fertilizers to ratoon crop, majority of the sugarcane farmers were aware of the right time of application (57.5 per cent) and method of application (74 per cent) of fertilizers. All the farmers

who had used fertilizers to ratoon crop had distributed it to the plots equally. The reasons for majority of the farmers following the above mentioned practices are that the sugarcane farmers had been properly guided and educated by extension workers (about the importance of such practices).

5.1.7.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Ratoon management

It is evident from the Table XV that about 47.5 per cent of the sustainable sugarcane farmers were found to be in low adoption level of ratoon management practices, whereas 19 and 33.5 per cent of the farmers belonged to medium and high adoption levels, respectively.

Lack of adequate knowledge and lack of technical guidance on the benefits of incorporation of leaf trash, non-availability of farm yard manure/compost and lack of knowledge on recommended quantity of fertilizers to ratoon crop are the main reasons for nearly half of the farmers (47.5 per cent) belonging to low level of adoption of ratoon management practices.

Practice of ratooning in sugarcane helps in reducing the cost of production and also obtaining the same yield as that of the main (first) crop (Nagarajan, 1992). Hence, sugarcane farmers should be encouraged to cultivate the ratoon crop with the same interest they have given to first crop.

5.1.8 Maturity and Harvesting

5.1.8.1 Extent of adoption of sustainable sugarcane farming practices by farmers in respect of Maturity and Harvesting

The data in Table XVI indicate that all the sustainable sugarcane farmers had followed the procedure of judging the maturity of the sugarcane crop. Majority (74.5 per cent) of the farmers had judged the maturity of the crop based on experience, while 15 and 10.5 per cent of the farmers had judged the crop maturity based on sucrose content in the cane juice and by trial boiling of cane juice, respectively. It is very essential to judge maturity of crop for timely harvest to get optimum yield.

The matured sugarcane crop was harvested by majority (63 per cent) of the farmers. These farmers had supplied cane to 'Khandsari' Sugarfactory and for jaggery preparation. Some of them were also able to get timely permit to supply canes for Sugarfactories. The rest of the sugarcane farmers (37 per cent) could not harvest the matured crop in time, since these farmers were under the contract of supplying cane to Sugarfactories. Farmers had not received permit from Sugarfactory to supply canes to them in time. Hence, 37 per cent of the farmers could not harvest the matured sugarcane crop in time. This speaks volumes about the administration of Sugarfactories and consequent inconvenience caused to the

sugarcane growers. The Sugarfactory personnel need to be educated by the farm scientist about the importance of timely harvest of the matured crop, otherwise there will be reduction of both cane and sugar yield.

The data also reveal that as many as 31 per cent of the farmers did not harvest the sugarcane crop at ground level. These farmers had hired the labour to harvest the crop. Labourers according to their whims and fancies had harvested the crop without knowing the fact that 4-5 tonnes of cane per acre would be wasted, if the crop is not harvested at ground level.

5.1.8.2 Adoption pattern of sustainable sugarcane farming practices by farmers in respect of Maturity and Harvesting

The results in Table XVII reveal that 46 per cent of the sustainable sugarcane farmers were found to be in medium level of adoption of maturity and harvesting practices, whereas 33.5 and 20.5 per cent of them belonged to high and low levels of adoption of maturity and harvesting practices, respectively. It can be inferred that as high as 79.5 per cent of the sugarcane farmers belonged to high/medium levels of adoption of maturity and harvesting practices. The reasons for this kind of finding might be due to the fact that majority of the farmers by their experience had judged the maturity of the sugarcane crop and had performed timely harvest and right method of harvesting the cane.

Since the sustainability of sugarcane farming has eight components namely, land preparation, seeds (setts) and sowing, sugarcane based cropping system, integrated nutrient management, water management, integrated pest management, ratoon management, and maturity and harvesting. The setforth hypotheses (H_1) that sustainability of sugarcane farming is a composite of several components is accepted.

5.1.9 Overall adoption pattern of sustainable sugarcane farming practices by farmers

Results in Table XVIII reveal that 36 per cent of the sustainable sugarcane farmers belong to low overall adoption level of sustainable sugarcane farming practices. On the contrary an equal number of farmers (32 per cent) were halved between medium and high overall adoption levels. It can be inferred that about 64 per cent of the farmers belonged to high/medium overall adoption levels of sustainable sugarcane farming practices.

Poor adoption of sugarcane based cropping system practices and ratoon practices are the reasons for more than one-third (36 per cent) of sugarcane farmers belonging to low overall adoption level of sustainable sugarcane farming practices.

Majority (64 per cent) of the sugarcane farmers belong to high/medium overall adoption levels of sustainable

sugarcane farming practices probably due to higher adoption of land preparation practices, seeds (setts) and sowing practices, integrated nutrient management practices, water management practices, integrated pest management practices, and maturity and harvesting practices.

5.2 Relationship and contribution of personal, behavioural, motivational, situational and extension factors (independent variables) on the adoption level of sustainable sugarcane farming practices

5.2.1 Relationship between personal, behavioural, motivational, situational and extension factors and the adoption level of sustainable sugarcane farming practices

Table XIX reveal that out of 30 independent variables, four variables namely had significant relationship with the adoption level of sustainable sugarcane farming practices at 5 per cent level and 15 variables had highly significant relationship at 1 per cent level. The remaining 11 variables exhibited non-significant relationship with the adoption level of sustainable sugarcane farming practices.

Achievement orientation, level of aspiration, self-reliance and farm scientist contact were the variables having significant relationship with the adoption level of sustainable sugarcane farming practices at 5 per cent level, whereas age, education, socio-economic status, knowledge about sustainable sugarcane farming technologies, attitude towards sustainable farming, economic motivation, farm size,

sugarcane farming experience, input self-sufficiency, mass media use, participation in training programme, extension agency contact and extension participation had highly significant relationship with the adoption level of sustainable sugarcane farming practices at 1 per cent level.

5.2.1.1 Personal Factors

5.2.1.1.1 Age : It is evident from the results that there exists a highly significant relationship between age and adoption level of sustainable sugarcane farming practices at 1 per cent level. Similar findings were observed by Jandhyala and Tilak (1993), Chandregowda (1996) and Chandregowda and Jayaramaiah (1996).

As the age advances, people become tame and docile. They prefer to get back to traditions and they find security in following old and indigenous practices. Most of the ecologists are old and matured people. And also, age and experience go together in the farming profession as the latter would normally depend on the other. Farmers who have cultivated sugarcane since their early years are aware of the ill effects of crossing nature's barriers. That is, practising intensive agriculture with more of agro-chemicals has resulted in deterioration of the soil health. This would have promoted them to practice sustainable farming. Hence, a significant relationship between age and adoption level of sustainable sugarcane farming practices is observed.

5.2.1.1.2 Education : The correlation co-efficient reveals that there is a positive and significant relationship between education and adoption level of sustainable sugarcane farming practices at 1 per cent level. The research studies of Jandhyala and Tilak (1993) and Chandregowda (1996) are in line with the findings of this study.

Education can cure most of the ills of the society is the basic belief. Formal schooling has been valued as a means of increasing knowledge about farm technology. Schooling facilitates learning which in turn presumed to instill a favourable attitude towards the use of ecofriendly farm practices. Education widens the vision of individuals and minds of people, orients them to outside world and provides new opportunities of life. Education provides an opportunity for people to expose themselves to mass media which carry messages of the ill effects of using chemicals and purchased inputs in agriculture, and calls for practising ecofriendly technologies, motivating the farmers to practice sustainable agriculture. Hence, a significant relationship between education and adoption level of sustainable sugarcane farming practices.

5.2.1.1.3 Socio-economic status : The results reveal that there is a positive and highly significant relationship between socio-economic status and adoption level of sustainable sugarcane farming practices at 1 per cent level.

The results of the findings are in conformity with the findings of Wasnik (1993) and Chandregowda (1996).

Socio-economic status in the present study consists of five elements, namely, occupation, land holding, annual income, type of house and material possession. Better status in the economic and social conditions of farmers enable them to have access to modern media of communication and also provides better extension contact, which carries the message of benefits for practising sustainable agriculture to get higher and sustainable yields. Farm size being one of the sub-components of socio-economic status, it is usually believed that larger farm size results in higher socio-economic status among farmers leading to put lesser pressure on natural resources. Usually, resource rich farmers practice sustainable agriculture as they are not worried about the immediate future. Hence, a significant relationship between socio-economic status and adoption level of sustainable sugarcane farming practices.

5.2.1.2 Behavioural Factors

5.2.1.2.1 Knowledge about sustainable sugarcane farming technologies : It was observed that knowledge about sustainable sugarcane farming technologies had a positive and significant relationship with the adoption of sustainable sugarcane farming practices at 1 per cent level. Similar

findings were observed by Rotti (1983), Kutty and Rao (1985), Kher and Halyal (1990) and Jayale and Nachane (1995).

Knowledge about sustainable sugarcane farming technologies possessed by the farmers would help them to adopt that practice in his land which inturn helps them in getting higher and sustainable yields. Possession of knowledge is a pre-requisite for the adoption of the practice. Hence, knowledge was found to have a significant relationship with adoption level of sustainable sugarcane farming practices.

5.2.1.2.2 Attitude towards sustainable farming : The results reveal that attitude towards sustainable farming had highly significant relationship with adoption level of sustainable sugarcane farming practices at 1 per cent level. The findings are in line with the findings reported by Chandregowda (1996) and Rao (1997).

The key attribute of an attitude is its evaluative component. That is, attitudes generally refer to individuals' disposition to respond positively or negatively to some aspect/object. So, when a farmer possesses a favourable attitude towards sustainable farming, he would have, naturally, evaluated its positive and negative implications of practising the same on his farm. As Beus and Dunlop (1994) have proved in their attitude - behaviour

relationship study, farmers attitude was the single most powerful variable that explained farmers' overall behaviour. Attitudes are harbingers of the activities that follow. A strong attitude to practice sustainable farming drives the farmers to acquire necessary knowledge, utilize the available resources, efficiently, so that his external dependency is reduced. Hence, a positive and significant relationship was observed between attitude and adoption level of sustainable sugarcane farming practices.

5.2.1.3 Motivational Factors

5.2.1.3.1 Management orientation : The results indicate a non-significant relationship between management orientation and the adoption level of sustainable sugarcane farming practices. The results are in conformity with the findings of Rameshbabu (1986) and Shivaraj (1996).

Management orientation in the present study is made up of planning, production and marketing orientation. Sugarcane is a long duration crop which comes up in 11 to 16 months depending upon the variety. Farmers involve themselves in less planning, since the crop is a long duration one and requires less management after planting. Hence, farmers opt for sugarcane rather than cultivating paddy which requires intensive management and care because of more incidence of pests and diseases, intercultivation, harvesting, processing, etc.

There is no ensured price for harvested canes in the market, because, the price of canes is fixed by the government depending upon the production. So, there is a lot of price fluctuation year after year. Since sugarcane cultivation involves less management, more and more farmers are producing it. Over-production has created less demand for the produce, thereby the price of canes is fluctuating year by year.

Environment is more powerful than individual management capacity. Prices are determined by the pull of demand and supply rather than management orientation. Hence, the management orientation of the sugarcane farmers was found to have no significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.3.2 Risk orientation : It is observed that there is a non-significant relationship between risk orientation and adoption level of sustainable sugarcane farming practices. However, the results are not in line with the finding reported by Reddy (1974).

Sugarcane is fairly a risk free crop from the angle of irrigation water, production, demand, yield and price. It is a stabilized crop. Only in few years where there is no demand for sugarcane, there is a price risk, otherwise it is risk free crop. Hence, the risk orientation of farmers was

not significantly related to the adoption level of sustainable sugarcane farming practices.

5.2.1.3.3 Scientific orientation : The results indicate that there is a non-significant relationship between scientific orientation and adoption level of sustainable sugarcane farming practices. The results of the findings are in line with the findings of Palaniswamy (1978) and Sakthivel (1979). However, the results are not in line with the findings reported by Reddy (1974), Sridharan (1981), Singh (1982) and Ramegowda (1983).

Sugarcane being a commercial crop, the farmers have accepted the scientific agriculture by way of using heavy farm machines, chemical fertilizers and hazardous pesticides to boost the crop yield to gain economic returns. Sugarcane farmers perhaps, are not conscious about the ill effects of using heavy farm machines and agro chemicals which cause environmental pollution, decline soil health resulting in reduced crop yields and income in the long run. Thus, the scientific orientation was not found significant with the adoption level of sustainable sugarcane farming practices.

5.2.1.3.4 Economic motivation : A perusal of the results indicates that relationship between economic motivation and adoption level of sustainable sugarcane farming practices are positive and highly significant. The findings are in

conformity with the findings of Reddy (1974) and Chandregowda and Jayaramaiah (1996).

Economic motivation is the basic character upon which other motives, drive and other attributes are built. It psychologically conditions an individual to motivate himself to achieve higher income. One could set higher levels of economic motivation, when one develops higher levels of motivation and wants to achieve, he could strive hard and get inter-relieved himself about different aspects of cultivation of sustainable sugarcane farming practices. Sugarcane farmers have perceived economic returns without damaging the basic resources and thus, have opted for adoption of sustainable sugarcane farming practices. The fact that sustainable agriculture should also be economical is proved here, the farmers who are motivated to get higher income do not necessarily fall back on chemical agriculture. They have a rational decision within the parameters of income and expenditure. Hence, it is quite natural to expect significant relationship between economic motivation and adoption level of sustainable sugarcane farming practices.

5.2.1.3.5 Value orientation : The results reveal that there is no significant relationship between value orientation and adoption level of sustainable sugarcane farming practices. However, the findings reported by Sheshachar (1980) and Chandregowda (1996) were not in conformity with the findings of the study.

Values make an individual emotionally committed to standards in such a way that they influence, guide and direct his behaviour. Sugarcane is purely a commercial crop grown to increase the income level of the farmers, hence farmers value higher income more than sustainability. Thus, the adoption level of sustainable sugarcane farming practices had non-significant relationship with the values of the farmers.

5.2.1.3.6 Achievement orientation : It can be observed from the results that achievement orientation had a positive and significant relationship with the adoption level of sustainable sugarcane farming practices at 5 per cent level. The findings reported by Renukaradhya (1983), Rao (1985) and Chandregowda (1996) are in line with the findings observed. However, the findings of Kumbar (1983) are not in line with the results observed.

Achievement orientation is the important determinant of excellence or perfection in what one does. In order to achieve this distinction, the farmers might have learnt the sustainable sugarcane farming practices meticulously and also might have adopted with adequate care to maximise and sustain both yield and income from sugarcane crop. The danger of chemical agriculture (i.e., the use of agro-chemicals like fertilizers and pesticides) has gone to their minds and infact they would like to protect their resources from degradation and at the same time achieve greater production.

This amply proves that those who want to achieve excellence do not do it at the cost of basic resources. They have rationality and think in terms of maximizing income or status without affecting their resources or environment. Hence, achievement orientation was found to have a significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.3.7 Level of aspiration : The results reveal that the level of aspiration and adoption level of sustainable sugarcane farming practices are having significant relationship at 5 per cent level. The results observed are in conformity with the findings of Chandregowda and Jayaramaiah (1996).

The level of aspiration is closely related to achievement orientation, which besides motivating an individual to achieve desired goals, would motivate him to achieve more. Action of an individual is reflective of his several socio-psychological phenomena like level of aspiration, attitude, belief, etc. Sugarcane farmers, who aspire to improve their farming enterprise and to earn higher and sustained profits would naturally strive hard to adopt the sustainable farming practices. Further, the sugarcane farmers might have stated their level of performance to be reached in the enterprise in view of their past performance and experience. This might have acted as an added factor to

better the adoption of sustainable farming practices in sugarcane. Hence, a significant relationship is observed between the level of aspiration and adoption level of sustainable sugarcane farming practices.

5.2.1.3.8 Innovativeness : It is evident from the results that innovativeness has non-significant relationship with the adoption level of sustainable sugarcane farming practices. The results observed is in line with the finding of Sinha and Kolte (1979). However, the findings reported by Rannorey (1979), Rao (1985) and Chandregowda (1996) are not in line with the findings observed.

Innovativeness is associated with accepting change leading to adoption of innovative ideas and scientific practices. Since sustainable agriculture mainly comprises of indigenous technology, the farmers are inhibiting the change from traditional sustainable agriculture to scientific chemical agriculture. The innovators who are not tradition bound will not likely to practice sustainable agriculture, which is almost against chemical agriculture and its accompaniments. Hence, innovativeness was found to have non-significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.3.9 Deferred gratification : It can be seen from the results that there is a non-significant relationship between

deferred gratification and the adoption level of sustainable sugarcane farming practices. However, the results reported by Ramesh and Jayaramaiah (1996) are not in conformity with the finding observed.

Sugarcane is an input intensive crop. The farmers have to spend most of their income towards the purchase of agricultural inputs like quality seeds (setts), organic manures and particularly, fertilizers and plant protection chemicals. The immediate want he has to satisfy is the purchase of agricultural inputs, followed by family expenses to meet social obligation and pay debts. Sometimes due to fluctuations in prices of cane in the market he is left with insufficient money even to meet the cost of production. Consequently, there is very little or no money will be left to save. Hence, deferred gratification was not significantly related to the adoption level of sustainable sugarcane farming practices.

5.2.1.3.10 **Cosmopoliteness** : The results indicate that cosmopoliteness has no significant relationship with the adoption level of sustainable sugarcane farming practices. However, the findings of Olosso (1988) is not in line with the result observed.

The sustainable agricultural practices mainly comprise of indigenous technology and the farmers practising it are

localities. Since the extension workers are encouraging more of chemical agricultural practices, these sustainable farmers might not have evinced necessary interest to know from them. Hence, cosmopolitaness was found to have non-significant relationship with adoption level of sustainable sugarcane farming practices.

5.2.1.3.11 Social participation : It is evident from the results that social participation is found to have a non-significant relationship with the adoption level of sustainable sugarcane farming practices. The findings observed are in agreement with the findings of Pamadi (1980). However, the finding of Somasundaram (1993) are not in agreement with the findings observed.

Social participation refers to the involvement of farmers in various social organizations and their activities as a member or as an office bearer. These social organizations are created by the villagers to meet a specific need such as to obtain credit, entertainment or to look after the village welfare. The society and the social organizations are not approving sustainable agriculture (which requires longer time to stabilize yield and income). They are after chemical agriculture to achieve higher yield to sustain their immediate family needs. When the social environment is not conducive for sustainable agriculture, it is going to be a slow process and becomes an uphill task to

move forward. Hence, the social participation was not found to be significantly related to the adoption level of sustainable sugarcane farming practices.

5.2.1.4 Situational factors

5.2.1.4.1 **Family size** : The results revealed that there is no significant relationship between family size and adoption level of sustainable sugarcane farming practices. However, the findings of Jayale and Nachane (1995) do not support the findings of the present study.

No doubt sugarcane is a labour intensive crop. In the absence of family labour, labour has to be hired to perform different activities of the crop. Thus, the crop production activities had not affected even if the size of the family was small. This result implies that sugarcane farmers depend heavily on hired labour for producing crop and there is very little family labour involved in agricultural operations in the study area. Hence, the family size was non-significantly related to the adoption level of sustainable sugarcane farming practices.

5.2.1.4.2 **Farm size** : It is evident from the results that the farm size had a positive and significant relationship with the adoption level of sustainable sugarcane farming practices at 1 per cent level. The above finding is in agreement with the findings reported by Muthuraman (1995) and Chandregowda (1996).

Farmers with larger holdings would put less pressure on natural resources, while farmers with less land holding exert more pressure on natural resources. Small farmers with less land holding exert lot of pressure on natural resources (like land, water, etc.) to feed their family i.e., there will be over exploitation of the resources. Big farmers will have an opportunity to diversify farming and resources as against small farmers following monocropping. Hence, the farm size was found to have a significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.4.3 Sugarcane farming experience : The results reveal that sugarcane farming experience has a positive and highly significant relationship with the adoption level of sustainable sugarcane farming practices. Similar findings were observed by Kumbar (1983), Chandregowda and Jayaramaiah (1996) and Karthikeyan et al. (1996).

As already mentioned, age and experience go together in the farming profession as the latter would normally depend on the other. Farmers who have cultivated sugarcane since the their early years must have been aware of the ill effects of crossing nature's barriers, i.e., practising intensive agriculture with more of agro-chemicals which results in pollution and deterioration of soil health. This would have prompted them to practice sustainable farming. Hence, a significant relationship between experience in sugarcane

farming and adoption level of sustainable sugarcane farming practices.

5.2.1.4.4 Herd size : It is observed that there exists no significant relationship between herd size and the adoption level of sustainable sugarcane farming practices.

Herd size refers to number of livestock and poultry birds possessed by farmers. Almost all the sugarcane farmers had 1-2 herds, because of no place for the animals to graze. The farmers sell the poultry manure instead of applying to sugarcane fields. Hence, herd size did not have significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.4.5 Self-reliance : It is observed that self-reliance is having significant correlation with the adoption level of sustainable sugarcane farming practices at 5 per cent level.

The possible explanation for the above findings could be that those individuals who have self-reliance set long term goals and design means to reach those goals. The self-reliant individuals will be having the wherewithals to reach new heights by increased adoption of sustainable farming practices to get increased and sustainable yields. Thus, it is logical to expect these findings.

5.2.1.4.6 Input self-sufficiency : The results reveal a strong correlation between input self-sufficiency and the

adoption level of sustainable sugarcane farming practices at 1 per cent level.

Self-sufficiency in agricultural inputs like seed (setts), organic manures etc., would help the sugarcane farmers not only in reducing the cost of production but also help in reducing the dependency on purchased inputs (fertilizers and pesticides) supplied by the external agencies. A farmer with high input self-sufficiency will be free to make decisions and will be independent in crop production process without much reliance on external agency to supply inputs. Whereas a farmer without input self-sufficiency will be depending on others for each and everything in the production process. Hence, there is a strong correlation between input self-sufficiency and the adoption level of sustainable sugarcane farming practices.

5.2.1.4.7 Farm mechanization : It is evident from the result that there is no significant relationship between farm mechanization and adoption level of sustainable sugarcane farming practices. However, the findings reported by Hanumarangaiah (1996) and Karthikeyan et al. (1996) are not in agreement with the findings observed.

Sugarcane farmers are conscious of the fact that the use of farm machineries in agriculture will bring soil compaction resulting in reduced crop yields. Hence, limited

use of farm machineries in sugarcane cultivation were made by the farmers. Many farmers will have no access to farm machineries since they are not easily and locally available. Hence, they were forced to use both human and bullock labour in place of machineries. Thus, it is logical to expect a non-significant relationship between farm mechanization and adoption level of sustainable sugarcane farming practices.

5.2.1.4.8 Farming commitment : A perusal of the results indicate that there is a positive and highly significant relationship between farming commitment and the adoption of sustainable sugarcane farming practices at 1 per cent level. Similar findings were observed by Chandregowda (1996) and Chandregowda and Jayaramaiah (1996).

Farming commitment is a sort of dedication not only to earn a living but also to keep the resource base alive and to earn the living on a continuous basis. With all the temptations of intensive agricultural practices which stresses on the use of agrochemicals, the committed farmers have resorted to sustainable farming because of long term considerations. Hence, farming commitment is found to have a highly significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.4.9 Land productivity : It is observed that land productivity has a positive and significant relationship with

the adoption level of sustainable sugarcane farming practices at 1 per cent level.

Use of high yielding sugarcane varieties by the farmers is the basis of getting greater productivity. Farmers have displayed high levels of aspiration, achievement orientation and economic motivation which have prompted them to adopt several means of achieving higher yields. This was evident from the investment on using quality setts purchased from Sugarfactories, organic manures and fertilizers. The confidence of getting assured yields has inspired them further to do so. In view of these things, it is possible to get higher yields per unit area. Hence, there is a high significant relationship between land productivity and adoption level of sustainable sugarcane farming practices.

5.2.1.5 Extension Factors

5.2.1.5.1 Mass media use : It is seen from the results that the mass media use has a significant relationship with the adoption level of sustainable sugarcane farming practices at 1 per cent level. Similar findings were observed by Srinath (1982) and Prakashkumar (1986).

The higher levels of mass media use would facilitate the farmers to develop habits of gathering more information about sustainable sugarcane farming practices through radio, television, newspaper and other literature. Such farmers

readily accept the sustainable practices than others, who do not use the mass media. In other words, the use of mass media develops orientation among farmers which makes them more prone to acquire, retain and evaluate the sustainable farming practices leading to adoption of it. Mass media also provides enormous opportunities for repeated exposure to sustainable practices, motivating the farmers to adopt it. Hence, the use of mass media was found to have a significant relationship with adoption level of sustainable sugarcane farming practices.

5.2.1.5.2 Participation in training programmes : The results reveal a significant relationship between participation in training programmes and the adoption level of sustainable sugarcane farming practices at 1 per cent level. Similar findings were observed by Himantharaju (1984).

Training is an investment to upgrade the human resource. It brings changes in knowledge and skills related to one's job and profession. Training provides defreezing of old behaviour and refreezing of new behaviour for application leading to their success in managing the enterprise as well as realizing increased and sustained profits. Thus, the training on sustainable sugarcane farming practices must have established positive and significant relationship with the adoption level of sustainable sugarcane farming practices.

5.2.1.5.3 Farm scientist contact : It is evident from the results that farm scientist contact has a significant relationship with the adoption level of sustainable sugarcane farming practices at 5 per cent level. The findings are in line with the findings reported by Chandregowda (1996).

It is obvious that farmers with high level of farm scientist contact are generally favourable and predisposed to acquire more information, skills and other factors relating to sustainable farming practices. Consequently, their levels of adoption of sustainable farming practices are at higher levels. Thus, in this study a positive and significant relationship has been established between farm scientist contact and adoption level of sustainable sugarcane farming practices.

5.2.1.5.4 Extension agency contact : Extension agency contact is found highly significant with the adoption level of sustainable sugarcane farming practices at 1 per cent level. The above finding is in line with the findings of Jha and Shakthawat (1972), Palavannan (1985), Chandregowda (1996), Karthikeyan et al. (1996) and Shivaraj (1996).

Extension professionals not only communicate latest developments in research laboratories but also communicate the developments in other farmers' fields. Collecting information on sustainable practices from research

laboratories and from different farmers is possible through extension agency. Farmers with a high level of extension agency contact, will consequently adopt the sustainable farming practices. Hence, there is a positive and significant relationship between the extension agency contact and the adoption level of sustainable sugarcane farming practices.

5.2.1.5.5 Extension participation : Extension participation is highly significantly related to the adoption level of sustainable sugarcane farming practices at 1 per cent level. The findings are in agreement with the findings reported by Kher (1989) and Shivaraj (1996).

Participation in extension activities like demonstration, discussion, meetings, field days, campaigns, etc., promotes the acquisition of knowledge about sustainable farming practices and consequent adoption of these practices resulting in higher and sustainable yields. Hence, extension participation had a high significant relationship with adoption level of sustainable sugarcane farming practices.

With this foregoing discussion, the hypotheses (H_2) set for the study that the personal, behavioural, motivational, situational and extension factors (independent variables) do not have significant relationship with the adoption level of sustainable sugarcane farming practices was rejected in

favour of the alternative hypotheses that there is a significant relationship between the personal, behavioural, motivational, situational and extension factors and the adoption level of sustainable sugarcane farming practices.

5.2.2 Contribution of personal, behavioural, motivational, situational and extension factors on the adoption level of sustainable sugarcane farming practices

The regression analysis of the data in Table XX shows $R^2 = 0.885$ that is, nearly 89 per cent of the adoption of sustainable sugarcane farming practices is explained by 30 independent variables and the other 11 per cent is by some other variables. Among the selected variables, five variables namely, knowledge about sustainable sugarcane farming technologies, attitude towards sustainable farming, land productivity, farm scientist contact and extension participation were significantly contributing to the adoption of sustainable sugarcane farming practices.

Knowledge about sustainable sugarcane farming technologies, attitude towards sustainable farming, land productivity, farm scientist contact and extension participation have synergetic effects on one another, helping each other to have a positive relation in the adoption of sustainable sugarcane farming practices.

Since, the personal, behavioural, motivational, situational and extension factors (independent variables)

have a contribution of 89 per cent on the adoption level of sustainable sugarcane farming practices, the hypotheses (H_3) stating that the personal, behavioural, motivational, situational and extension factors do not contribute for the adoption level of sustainable sugarcane farming practices is rejected. Therefore, the alternative hypotheses stating that personal, behavioural, motivational, situational and extension factors have a contribution on the adoption level of sustainable sugarcane farming practices is accepted.

5.3 Effect of personal, behavioural, motivational, situational and extension factors contributing to the adoption of sustainable sugarcane farming practices

A birds eye view of Table XXI reveals that out of 30 independent variables, 19 variables were identified as having a significant relationship with the adoption level of sustainable sugarcane farming practices. Among these 19 variables, 13 variables were found to have positive direct effect, while the remaining 11 variables had negative but direct effect on the adoption of sustainable sugarcane farming practices.

As per the ranking of the variables based on their direct effect on the adoption level of sustainable sugarcane farming practices, knowledge about sustainable sugarcane farming technologies, farm scientist contact, attitude towards sustainable farming, sugarcane farming experience and

extension participation stood as first, second, third, fourth and fifth ranks (positions) in that order. Further, the perusal of the Table also revealed that farm size, extension participation, input self-sufficiency, attitude towards sustainable farming and education gained first five ranks in that order in respect of total indirect effect. Apart from this, the first largest indirect effect was channeled through knowledge about sustainable sugarcane farming technologies, followed by attitude towards sustainable farming.

Knowledge about sustainable sugarcane farming technologies and attitude towards sustainable farming had direct, indirect and largest indirect effects on the adoption of sustainable sugarcane farming practices. Possession of knowledge about sustainable sugarcane farming technologies is a prerequisite for the adoption of sustainable sugarcane farming practices to get increased and sustainable yields. Knowledge in turn is influenced by farm scientist contact, attitude towards sustainable farming, sugarcane farming experience and extension participation. Likewise, the attitude towards sustainable farming is influenced by sugarcane farming experience and extension participation.

Therefore, knowledge about sustainable sugarcane farming technologies and attitude towards sustainable farming were found to be not only having major direct effect on the adoption level of sustainable sugarcane farming practices,

but also through indirect and largest indirect effects influencing the adoption. Hence, these variables, viz., knowledge about sustainable sugarcane farming technologies and attitude towards sustainable farming were the dominant variables through which other variables can influence the adoption. Knowledge about sustainable sugarcane farming technologies can be considered as the forerunner of the adoption of sustainable sugarcane farming practices.

Possession of knowledge is a prerequisite for the adoption of any agricultural practices. Hence, the knowledge about the sustainable sugarcane technologies of farmers had contributed immensely for the adoption of sustainable sugarcane farming practices.

5.5 Discriminating the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices

Discriminant function analysis technique was employed in identifying the personal, behavioural, motivational, situational and extension factors which could discriminate between high and low adoption levels of sustainable sugarcane farming practices and further to find out the percentage contribution of individual variables to the total distance measured.

The results of this is explained in Table XXII. The statistic value of Mahalanobis ' D^2 ' and 'F' ratio calculated

were 44.27 and 39.17, respectively. The 'F' ratio was found to be significant at 1 per cent level. Hence, the distance between high and low adoption levels of sustainable sugarcane farming practices was significant. This implies that 30 independent variables together were found to be useful in discriminating the high and low adoption levels. This may be well explained by the reasons that the variables are selected based on the knowledge gained, the review of literature and appropriateness of the variables to sugarcane farmers. Hence they are contributing to the adoption. Further, a probe into the Table reveals that knowledge about sustainable sugarcane farming technologies, farm size, attitude towards sustainable farming, extension participation, mass media use, input self sufficiency and education occupied first seven ranks (positions) in discriminant function analysis. The calculated discriminant scores ' Z_1 ' and ' Z_2 ' for low and high adoption levels were 85.72 and 127.74, respectively. The critical value of discriminant scores (Z) for these two groups was 62.51.

Now, the developed discriminant function can be used to predict whether the sugarcane farmer would likely to belong to low adoption or high adoption group of sustainable sugarcane farming practices. If the value of the discriminant score of a selected sugarcane farmer is less than a score of 62.51, it would be predicted that he would

belong to low adoption group, and a score of 62.51 and more it would indicate a tendency that he would belong to high adoption group.

By this 'Z' value and 'F' value, it can be concluded that difference between low and high adoption groups is significant. While computing discriminant function analysis the medium adoption group was ignored, taking only low and high adoption groups. Hence, it is quite natural to get this type of result.

Since the personal, behavioural, motivational, situational and extension factors discriminate between high and low adoption levels of sustainable sugarcane farming practices, the hypotheses (H₄) stating that the personal, behavioural, motivational, situational and extension factors do not discriminate high and low adoption levels of sustainable sugarcane farming practices is rejected and the alternative hypotheses stating that the personal, behavioural, motivational, situational and extension factors discriminate the high and low adoption levels of sustainable sugarcane farming practices is accepted.

5.5 Components contributing to sustainable sugarcane farming as perceived by farmers

It could be observed from the Table XXIII that the most important components contributing to sustainable sugarcane

farming as perceived by farmers are application of farm yard manure/compost (99 per cent), application of biofertilizers (85 per cent), adoption of hot water treatment of setts to prevent disease (78.5 per cent), proper water management practices before, during and after fertilizer application (74.5 per cent), non-dependency on chemical pesticides (70.5 per cent), good knowledge on sustainable sugarcane technologies (66 per cent), adoption of intercropping (63 per cent), availability of technical guidance from extension workers on sustainable sugarcane farming practices (62.5 per cent), balanced use of fertilizers (54.5 per cent), non-dependency on farm power (53.5 per cent) and application of press mud (52 per cent) in that order.

As a result of technical guidance received by sugarcane farmers from extension workers on sustainable sugarcane farming practices, the farmers were able to possess good knowledge on such technologies which has influenced them to adopt. Organic manures like farm yard manure/compost, biofertilizers, press mud, intercropping with legumes and balanced use of fertilizers adds nutrients and improves the soil fertility. Proper water management practices is essential to get good crop yield. Dependency on chemical pesticides affects the soil health and dependency on farm machineries would affect the soil structure.

Release of *Trichogramma* egg parasites to control early shoot borer is the next important component contributing to sustainable sugarcane farming as perceived by half (50 per cent) of the sustainable sugarcane farmers. The extension workers should supervise the availability of *Trichogramma* egg parasites and see that it is available in time so that farmers can have easy accessibility. Also, the extension workers should convince the farmers about the release of *Trichogramma* egg parasites to control early shoot borer on sugarcane crop.

The least important components contributing towards sustainable sugarcane farming as perceived by the farmers are adoption of salt tolerant sugarcane variety (35 per cent), application of green leaf manure (34.5 per cent), adoption of crop rotation (14.5 per cent), application of micronutrients (10.5 per cent), application of soil amendments (6 per cent) and application of crop residues (1 per cent). The extension workers should motivate the farmers to adopt green manuring, crop rotation, micronutrients, soil amendments and crop residues by organizing trainings and conducting demonstrations on farmers' field, which helps the farmers to get convinced about the sustainable technologies which in turn help for greater adoption and larger productivity.

SUMMARY

CHAPTER VI

SUMMARY

The sustainability of intensive agriculture with the adoption of modern technology and inputs is in great doubt because of the associated problems of soil degradation, pesticide accumulation, poor water management, gene erosion, atmospheric and water pollution. The limitations of modern agriculture has been recognized by farmers and scientists all over the world. Efforts are being made to identify alternative farming methods which are ecologically sound, viable and sustainable. Such efforts made by farmers and scientists, to identify alternative farming methods, which are less dependent on purchased inputs has led to what is called "Sustainable Agriculture".

It has been reported that farmers who have adopted such alternative farming methods are getting yields on par with the modern agriculture using chemical fertilizers, insecticides and machinery.

Sugarcane is a very exhaustive crop. In order to boost production, farmers are using more of fertilizers, pesticides, weedicides and water in large quantities. Deliberate use of these purchased inputs has resulted in the decline of soil fertility and reduced yields over the years. Now, the farmers are realizing that their basic resource i.e., soil is spoiled and it needs to be

replenished. Farmers are motivated to rectify the imbalance and look for sustainable practices which can maintain the soil fertility intact and at the same time increase productivity.

There is a wide gap between the available sustainable sugarcane technologies and its application in the field. This study addresses itself to find out this gap and to develop suitable extension strategy to bridge the gap in the interest of resource base and environmental pollution.

The specific objectives of the study are :

1. To develop an index to measure the package of sustainable practices in sugarcane.
2. To know the levels of adoption of sustainable sugarcane farming practices among sugarcane farmers.
3. To find out the significant relationship between the adoption level of sustainable sugarcane farming practices of farmers and their personal, behavioural, motivational, situational and extension factors.
4. To discriminate the personal, behavioural, motivational, situational and extension factors responsible for high and low adoption levels of sustainable sugarcane farming practices.
5. To find out the components contributing to sustainable sugarcane farming as perceived by farmers.

The study was conducted in ten randomly selected villages of Srirangapatna taluk in Mandya district of Karnataka State during June 1997. The selected villages were Anandur, Baburayanakoppal, Belagola, Darasaguppe, Ganjam,

Hosahalli, Karekura, Kirangur, K. Shetahalli and Srirangapatna. From each of the ten selected villages, 20 sugarcane farmers who had followed ratoon and had harvested atleast three crops were selected using purposive random sampling method. Thus, the total sample constituted 200 sugarcane farmers from 10 villages.

An index was developed by using standard procedures while identifying components, working out scale values and then combining them to arrive at Sustainable Technology Adoption Index. The index was tested for its reliability and validity. This index was used to measure the sustainability of sugarcane farming. Data were collected through personal interview method. The collected data were scored, tabulated and analyzed keeping in view the objectives of the study. Important findings are summarized below.

1. Majority (53.5 per cent) of the sustainable sugarcane farmers had used bullocks to plough the land. All the farmers had prepared the land into ridges and furrow to plant setts.

High and low adoption levels of land preparation practices were observed in 53.5 and 46.5 per cent of the sustainable sugarcane farmers, respectively.

2. Majority of over 60 per cent of the sustainable sugarcane farmers had selected setts from main (first) crop

for planting, used recommended quantity of setts, selected setts having 2-3 eye buds, used setts of correct age for planting, selected top internodes as setts in the case of old and overmatured crop and adopted recommended spacing.

As high as 74 per cent of the sustainable sugarcane farmers were found to be in high/medium adoption levels of seeds (setts) and sowing practices.

3. Vast majority of over 80 per cent of the sustainable sugarcane farmers were not practising crop rotation, while majority (63 per cent) of sugarcane farmers were practising intercropping with legume.

As high as 87.5 per cent of sustainable sugarcane farmers belonged to low/medium adoption categories in sugarcane based cropping system.

4. Only five per cent of the sugarcane farmers had tested the soil before planting main (first crop).

Majority of over 50 per cent of the farmers had used organic manures (farm yard manure/compost, biofertilizer and press mud) and fertilizers to sugarcane crop. Very few farmers had applied green manures, micronutrients and soil amendments, while almost all the sugarcane farmers (99 per cent) had not used crop residues (cane stubbles and leaf trash). More than 50 per cent of the farmers had partially

adopted the recommended quantity of organic manures, while majority (54.5 per cent) of them had followed complete adoption of recommended quantity of fertilizers to sugarcane crop.

Almost all the farmers who had applied organic manures, fertilizers and soil amendments to sugarcane crop had followed the right time of application, correct method of application and had uniformly distributed in the sugarcane fields.

As high as 62.5 per cent of the sustainable sugarcane farmers belonged to high/medium levels of adoption of integrated nutrient management practices.

5. All the sustainable sugarcane farmers had followed furrow method of irrigation, while majority (75.5 per cent) of the farmers had followed the recommended frequency of irrigating the crop. Majority of the farmers had taken control measures to tackle excess salt, water logged and water deficit conditions.

Majority (61 per cent) of the sustainable sugarcane farmers belonged to high/medium adoption levels of water management practices.

6. Majority (50.5 per cent) of the sustainable sugarcane farmers had controlled weeds by hand weeding, while 30 and 19.5 per cent of them had controlled it by

practising intercultural operations and by using herbicides, respectively.

All the sustainable farmers had used disease free setts. Majority (60 per cent) of them had adopted hot water treatment to setts. About 22 per cent of the farmers did not take up any control measure to overcome the menace of brown leaf spot disease.

Termite attack was noticed by 27 per cent of the sugarcane farmers and all of them had taken control measures. Among the farmers who had the termite problem on their sugarcane crop, half of them (50 per cent) had adopted the biological measures (release of *Trichogramma* egg parasites) to control it.

As high as 65 per cent of the sustainable sugarcane farmers belonged to high/medium adoption levels of integrated nutrient management practices.

7. Majority of over 65 per cent of the sustainable sugarcane farmers had practised ratoon at right time and performed shoulder breaking and stubble shaving operations in ratoon crop. Only one per cent of the farmers had incorporated leaf trash to ratoon crop.

Higher percentage of sustainable sugarcane farmers (47.5 per cent) were found in low adoption level of ratoon management practices.

8. All the sustainable sugarcane farmers had judged the maturity of crop to harvest it. Majority (63 per cent) of the farmers had harvested the matured crop at the right time, while 69 per cent of them had harvested the crop at ground level to get optimum yield.

Vast majority (79.5 per cent) of the sustainable sugarcane farmers belonged to high/medium levels of adoption of maturity and harvesting practices.

9. About 36 per cent of sustainable sugarcane farmers belonged to low level of overall adoption of sustainable sugarcane farming practices as against 32 per cent each in high and medium groups.

10. The correlation co-efficient between the adoption level of sustainable sugarcane farming practices and 30 independent variables indicated that, only 19 variables were having significant relationship and the other 11 variables were non-significant with the adoption level.

Four variables, namely, achievement orientation, level of aspiration, self-reliance and farm scientist contact were significant at 5 per cent level with the adoption level of sustainable sugarcane farming practices, while 15 variables namely, age, education, socio-economic status, knowledge about sustainable sugarcane farming technologies, attitude towards sustainable farming, economic motivation, farm size,

sugarcane farming experience, input self-sufficiency, farming commitment, land productivity, mass media use, participation in training programme, extension agency contact and extension participation were highly significant (1 per cent level) with the adoption level of sustainable sugarcane farming practices.

11. The regression analysis of adoption level of sustainable sugarcane farming practices with 30 independent variables indicated that only five variables namely, knowledge about sustainable sugarcane farming technologies, attitude towards sustainable farming, land productivity, farm scientist contact and extension participation were significant in predicting the variation in the adoption level of sustainable sugarcane farming practices.

12. Direct, indirect and largest indirect effects of 19 selected independent variables on adoption level of sustainable sugarcane farming practices were analyzed and the results showed that 13 variables were found to have positive direct effect and remaining six variables showed negative direct effect on the adoption of sustainable sugarcane farming practices. The largest indirect effect was channeled through knowledge about sustainable sugarcane farming technologies followed by attitude towards sustainable farming.

13. Discriminant function analysis was found to be significant at one per cent level in discriminating between the high and low adoption levels of sustainable sugarcane farming practices. The distance measured by important variables revealed that first seven ranks goes to knowledge about sustainable sugarcane farming technologies, farm size, attitude towards sustainable farming, extension participation, mass media use, input self-sufficiency and education in that order.

14. Application of farm yard manure/compost, use of biofertilizers, adoption of hot water treatment of setts to prevent disease, proper water management practices before, during and after fertilizers application, non-dependency on chemical pesticides, good knowledge on sustainable sugarcane farming practices, adoption of intercropping, availability of technical guidance from extension workers on sustainable sugarcane farming practices, balanced use of fertilizers, non-dependency on farm power and application of press mud were the important components contributing to sustainable sugarcane farming as perceived by a majority of over 50 per cent of the sustainable sugarcane farmers.

IMPLICATIONS AND RECOMMENDATIONS

Results of the present study have ample implications for academicians, policy makers, researchers and farmers.

1. Sustainable agriculture in sugarcane can be practiced if farmers give more consideration to organic manures, crop rotation, intercropping, judicious water management, ratoon management and cultural, mechanical and biological measures to fight pests rather than what they are giving to inorganic fertilizers and chemical means of controlling pests. Hence, the sugarcane farmers need to be educated on the advantages of practising crop rotation, intercropping, integrated nutrient management, water management, integrated pest management and ratoon management.

2. Sugarcane farmers need to be taught about effective planning of crop rotation and intercropping with a short duration legume, and about the compost, green manures biofertilizers, press mud and crop residues (cane stubbles and leaf trash). These practices not only save money by reducing the use of inorganic fertilizers, but also improve the soil fertility.

3. The task is obvious that the farm scientists, extension field functionaries and Sugarfactory personnel should educate the farmers regarding the ill effects of imbalanced and indiscriminate use of inorganic fertilizers. Advantages of split application of urea and regular application of micronutrients are not known to sugarcane farmers. Their crude faith on inorganic fertilizers and

"more the fertilizers"; "better the yields", should be removed from the minds of the farmers.

4. In order to promote sustainable agriculture, the farm scientists should develop more and more non-cash and low cost technologies. Adoption of non-cash and low cost technologies in crop cultivation results in the reduction of production cost, thereby, lowering per unit cost of the output.

5. Due to rise in the cost of production the ratoon crop is virtually treated as a free crop by the farmers, since no cost is involved in land preparation and on seed material. Hence, practising ratoon in sugarcane should be encouraged among the farmers as ratoon crop not only reduces the cost of production but also yields more or less the same tonnage of cane as that of the main (first) crop.

6. There is a great need on the part of the Sugarfactory authorities to issue timely permit to farmers to harvest the matured crop in time, which helps in getting good sugar recovery and cane yield per unit area.

7. The findings of the study have categorically revealed that the extension factors such as mass media use, participation in training programmes, farm scientist contact, extension agency contact and extension participation have been found to make significant contribution to the adoption

of sustainable sugarcane farming practices. This implies that these variables have had mighty contribution for the adoption of sustainable sugarcane farming practices. Karnataka State Department of Agriculture, Agricultural Universities and Sugarfactories need to provide basically the extension factors first and other factors next in order to increase the adoption level of sustainable sugarcane farming practices.

8. Among the 30 independent variables studied, knowledge about sustainable sugarcane farming technologies has a direct link with the adoption of sustainable sugarcane farming practices. Therefore, the farmers' knowledge needs to be increased by providing ample opportunities to participate in training programmes and extension activities like demonstrations, discussions, field visits, Krishi melas, etc. Frequent contacts with farm scientists and formal extension workers such as Agricultural Assistants, Extension Guides, Cane Development Officers, Agricultural Officers etc., would increase the knowledge of farmers on sustainable sugarcane farming practices leading to adoption of the same on their fields.

9. Socio-economic status and farm size have emerged as important variables influencing the adoption of sustainable sugarcane farming practices. In view of the Indian succession act the land is going to be further divided making

it unavailable and uneconomical for agricultural operations. In such a situation, practising sustainable agriculture in Indian condition (where a vast majority of holdings are small) will be practically impossible in future days. Hence, the farmers need to be supported by other enterprises such as dairy, poultry, sericulture, piggery, fisheries, sheep and goat rearing so as to enable farmers to improve their socio-economic conditions and this diversification naturally promotes sustainable agriculture by way of providing farm yard manure and helps in recycling of farm wastes.

10. Higher levels of achievement orientation, economic motivation and level of aspiration might have prompted the sugarcane farmers to concentrate on short term gains from sugarcane farming. In the interest of mankind and the nature, farmers should develop strong commitment and a favourable attitude towards sustainable farming so as to attain long term gains of sugarcane farming.

11. Education and mass media have greatly influenced the adoption of sustainable sugarcane farming practices. Mass media educate and increases the knowledge of farmers by providing enormous opportunities for repeated exposure to sustainable practices in sugarcane cultivation, making them to take positive steps for the adoption of the same on farmers fields. Therefore, it is important that there is a need to present useful and necessary applicable messages on

sustainable sugarcane practices through mass media like radio, television, newspaper, agricultural magazines, etc.

As on now, sustainable practices are available on bits. There is a greater need for these sustainable practices to be given to farmers in a package form. Effective linkage between research, extension and farmers system should help in identifying the problems faced by farmers in the adoption of sustainable practices, ultimately arriving at the most appropriate solutions through onfarm research and onfarm trials.

Suggestions for future research

Following suggestions are made for the use of future researchers who undertake studies related to sustainability.

1. The evolved sustainable technology adoption index has to be better made use of in different 'crop based' or 'enterprise based' farming systems.

2. The components of sustainability of sugarcane farming need to be verified for different purposes and the suitable modifications in terms of addition, replacement or deletion of components is done without reducing the validity of such an index.

3. Since sugarcane is cultivated in different agro-climatic zones and the sustainable practices also varies from location to location, it is desirable that the studies of this kind are repeated in different agro-climatic zones and validated.

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CHAPTER VII

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APPENDICES

THE UNIVERSITY OF AGRICULTURAL SCIENCES

Dr.K.S. KRISHNA
Professor & Head

Department of Agril. Extension
Hebbal, Bangalore - 560 024

October 10, 1996

Dear Sir,

I am glad to inform that Sri.M.T. Lakshminarayan, a Ph.D. student of Agricultural Extension is pursuing a research study entitled "Adoption of Sustainable Sugarcane Farming Practices by Farmers - An Aanalysis" under my guidance. As a part of the study, the student is trying to develop an index to measure sustainability of sugarcane farming.

In this connection, some components and its items on sustainable sugarcane farming have been listed in Annexure based on review of literature and discussion with a few experts. Considering your high academic qualifications and rich experience, we are pleased to seek your valuable judgement on the relevancy of these components and its items. Please make specific judgements of items under each components on three point continuum by ticking (✓) in the appropriate column. You are also requested to suggest any other pertinent item(s) that you consider important for sustainability of sugarcane farming.

I, therefore, request you to kindly spare some of your valuable time and help in the research. The filled in proforma may please be mailed back to the researcher within a week's time.

With kind regards,

Yours sincerely,

Sd/-
(K.S. Krishna)

Sustainability of sugarcane farming has been operationalised as the process by which a farmer manages soil and water on his farm relying mainly on onfarm resources (i.e., the use of locally available resources, non-cash and low cost inputs and minimising the use of chemicals) to maintain or enhance productivity without affecting the production environment.

The main components of sustainable sugarcane farming practices identified are (I) Land preparation, (II) Seeds (setts) and sowing, (III) Sugarcane based cropping system, (IV) Integrated nutrient management, (V) Water management, (VI) Integrated pest management, (VII) Ratoon management, and (VIII) Maturity and harvesting.

Note : Please tick against statement [The relevancy of scale is HR = Highly Relevant; R = Relevant and NR = Not Relevant, which carries a score of 2, 1 and 0, respectively].

Sl. No.	Components and its technologies (Items)	Relevancy of the technologies			Co-efficient of variation values	Item analysis ('r' values)
		HR	R	NR		
1	2	3	4	5	6	7
I. Land preparation :						
1.	Ploughing the land				11.54	0.752**
2.	Preparing the land for planting canes in ridges and furrows				19.53	0.711**
II. Seeds (setts) and sowing						
3.	Selection of correct age setts for planting				8.42	0.820**
4.	Number of setts for a given area				5.16	0.869**
5.	Number of buds per sett				10.00	0.799**
6.	Selection of setts for planting from first/main crop				2.50	0.899**
7.	Selection of setts for planting from ratoon crop				100.00	-

APPENDIX-Ia contd..)

1	2	3	4	5	6	7
8. Selection of top internodes as setts in the case of old and overmatured crop					26.00	0.690**
9. Recommended spacing					6.30	0.849**
III. Sugarcane based cropping system						
10. Crop rotation					11.30	0.779**
11. Intercropping					14.28	0.749**
IV. Integrated nutrient management						
A.12. Soil testing					9.49	0.799**
B. Organic manures						
13. Application of FYM/compost					8.42	0.829**
14. Application of green leaf manure					11.22	0.780**
15. Application of bio-fertilizers					11.79	0.771**
16. Application of crop residues (cane stubbles/leaf trash)					11.11	0.781**
17. Application of press mud					14.20	0.750**
18. Quantity of organic manures applied per unit area					5.16	0.868**
19. Time of application of organic manures					18.67	0.722**
20. Method of application of organic manures					10.00	0.790**
21. Distribution of organic manures to all plots equally					3.59	0.891**

APPENDIX-Ia contd..)

1	2	3	4	5	6	7
C. Inorganic manure (fertilizers)						
22. Nature of fertilizer used					79.30	-
23. Quantity to be applied per unit area					5.16	0.861**
24. Time of application					6.30	0.841**
25. Method of application					9.18	0.810**
26. Distribution to all plots equally					4.44	0.881**
D.27. Application of micronutrients					18.33	0.729**
E.28. Application of soil amendments					15.79	0.740**
V. Water management						
29. Frequency of irrigation depending on soil type					13.00	0.760**
30. Method of irrigation					15.93	0.736**
31. Water management practices of soil affected by salts					12.27	0.761**
32. Water management practices under water shortage condition					12.19	0.769**
33. Water management practices under excess/water-logged condition					9.49	0.799**
VI. Integrated pest management						
A. Integrated weed management						
34. Cultural method of controlling weeds					10.62	0.798**
35. Mechanical method of controlling weeds					15.93	0.739**
36. Use of herbicides					25.30	0.692**

APPENDIX-Ia contd..)

1	2	3	4	5	6	7
B. Integrated insect management						
(a) Control of termites						
37. Cultural method					23.90	0.702 ^{**}
38. Use of chemicals					28.80	0.690 ^{**}
(b) Control of early shoot borer						
39. Cultural method					14.10	0.752 ^{**}
40. Biological method					5.82	0.853 ^{**}
41. Use of chemicals					80.00	-
C. Integrated disease management						
(a) Preventive measures						
42. Use of disease free seed (setts) material					13.97	0.759 ^{**}
43. Use of hot water treated seed material (setts)					17.00	0.730 ^{**}
44. Uprooting and burning the yellow clumps					14.28	0.741 ^{**}
(b) Control of brown eye leaf spot disease						
45. Cultural method					15.93	0.739 ^{**}
46. Use of chemicals					80.50	-
VII. Ratoon management						
47. Time of ratooning practised					13.49	0.759 ^{**}
48. Performing gap filling operation					5.82	0.859 ^{**}
49. Incorporation of leaftrash					13.48	0.758 ^{**}

APPENDIX-Ia contd..)

1	2	3	4	5	6	7
50.	Performing stubble shaving operation				14.10	0.752**
51.	Performing shoulder breaking operation				12.90	0.762**
(b) Integrated nutrient management in ratoon crop						
(i) Use of organic manure						
52.	Quantity of FYM/compost applied per unit area				8.08	0.831**
(ii) Use of inorganic manure						
53.	Nature of fertilizer used				94.50	-
54.	Quantity of fertilizer applied per unit area				10.11	0.789**
55.	Time of fertilizer application				10.75	0.783**
56.	Method of fertilizer application				14.92	0.742**
57.	Distribution of fertilizer to all plots equally				23.83	0.709**
VIII. Maturity and Harvesting						
58.	Judging the maturity for timely harvest				19.17	0.721**
59.	Time of cane harvest				18.38	0.729**
60.	Method of cane harvest				19.30	0.719**

Note : Item/Technology number 7, 22, 41, 46 and 53 were found to be irrelevant sustainable technologies, based on coefficient of variation values (C.V.). If C.V. values exceeds a value of 30, that particular technology is not relevant. Based on item analysis (correlation method), the 'r' values of 55 selected technologies (after deleting five technologies out of 60 technologies) was more than table 't' value i.e., 0.201 at 5 per cent level (*) and 0.262 at 1 per cent level (**). These 55 technologies/items were found to be significant and were included for further investigation.

APPENDIX Ib

Adoption of Sustainable Sugarcane Farming by Farmers - An AnalysisINTERVIEW SCHEDULE

I. General Information

1. Farmer Name :
2. Father Name :
3. Village : 4. Taluk :
5. District :
6. Sugarcane variety grown:
7. Ratooning practised : Yes/No

II. Sustainable Technologies in Sugarcane Farming (Numbers in the parenthesis indicates the scoring pattern followed)

1. Land preparation :

1.1.1 Ploughing the land using bullock power :	Yes / No (2) (0)
1.1.2 Ploughing the land using tractor/power tiller :	Yes / No (1) (0)
1.2 Preparing the land into ridges and furrows for planting setts :	Yes / No (1) (0)

2. Seeds (setts) and sowing :

2.1 Use of setts from 8-10 months old first crop : (for planting)	Yes / No (1) (0)
2.2 Number of setts per acre :	
2.2.1 Use of 10-12,000 setts/acre (i.e., as recommended)	Yes / No (2) (0)
2.2.2 Use of less than 10,000 setts/acre	Yes / No (1) (0)

- 2.3 Selecting setts from main/first crop for planting : Yes / No
(1) (0)
- 2.4 Selecting top internodes as setts in the case of
old and overmatured crop Yes / No
(1) (0)
- 2.5 Selecting setts having 2-3 eyebuda per sett Yes / No
(1) (0)
- 2.6 Following the recommended spacing Yes / No
(1) (0)
3. Sugarcane based cropping system
- 3.1 Crop rotation
- 3.1.1 Growing legume crop before the cane was planted Yes / No
(1) (0)
- 3.1.2 Growing either a legume/ragi crop after cane was
harvested Yes / No
(1) (0)
- 3.2 Intercropping
- Growing legumes in the cane field as an intercrop Yes / No
(1) (0)
4. Integrated nutrient management
- 4.1 Tested the soil before planting main/first crop :
- Tested (1)
Not tested (0)
- 4.2 Use of organic manures :
- 4.2.1.1 Application of farm yard manure/compost
- 4.2.1.1.1 Non adoption (0)
- 4.2.1.1.2 Partial adoption of less than 5 tons or 10 cartloads per acre (1)
- 4.2.1.1.3 Complete adoption as recommended i.e., 5 tons or 10 cartloads
per acre (2)
- 4.2.1.2 Time of application
- 4.2.1.2.1 Applying 1-3 weeks before planting (2)
- 4.2.1.2.2 Applying at an inappropriate time (1)

4.2.1.3 Method of application

4.2.1.3.1 Mixed with soil thoroughly (2)

4.2.1.3.2 Spread on the surface of the soil (1)

4.2.1.4 Distributing FYM/compost to all plots equally : Yes / No
(1) (0)

4.2.2 Application of green leaf manure

4.2.2.1.1 Applying of green leaf manure i.e., legumes to sugarcane plots	Yes / No (1) (0)

4.2.2.2 Time of application

4.2.2.2.1 Trampling 1-2 weeks before planting (2)

4.2.2.2.2 Trampling at an in-appropriate time (1)

[illegible]

4.2.3 Application of bio-fertilizers (Azospirillum/Azotobacter)

4.2.3.1 Quantity of bio-fertilizers used

4.2.3.1.1 Non adoption (0)

4.2.3.1.2 Partial adoption of less than recommended (1)

4.2.3.1.3 Complete adoption as per recommended (2)

4.2.3.2 Number of times applied

4.2.3.2.1 Two and more times at an interval of 30 days after planting (2)

4.2.3.2.2 Applying only once (1)

4.2.3.3 Method of application

4.2.3.3.1 Applying by opening small furrow near clumps and covering by soil (2)

4.2.3.3.2 Spread over soil surface (1)

4.2.3.4 Applying bio-fertilizer equally to all plots : Yes / No
(1) (0)

4.2.4.1 Application of crop residues (Cane stubbles and Trash) :

4.2.4.1.1	Use of stubbles and trash (2)	
4.2.4.1.2	Use of stubbles (1)	
4.2.4.1.3	Use of trash (1)	
4.2.4.1.4	Not applied (0)	
4.2.4.2	Applying crop residues uniformly to all plots : equally	Yes / No (1) (0)
4.2.5	Application of press mud	
4.2.5.1	Quantity of press mud used	
4.2.5.1.1	Not used (0)	
4.2.5.1.2	Partial adoption of less than 3 tons or 6 cartloads per acre (1)	
4.2.5.1.3	Complete adoption as recommended that is 3 tons or 6 cartloads per acre (2)	
4.2.5.2	Time of application	
4.2.5.2.1	Applying 2-3 weeks before planting (2)	
4.2.5.2.2	Applying at an inappropriate time (1)	
4.2.5.3	Method of application	
4.2.5.3.1	Mixed with soil thoroughly (2)	
4.2.5.3.2	Spread on surface of the soil (1)	
4.2.5.4	Distributing pressmud to all plots equally :	Yes / No (1) (0)
4.3	Use of inorganic manure (fertilizers)	
4.3.1	Quantity of fertilizers used	
4.3.1.1	Use of complete dose of nitrogen (2)	
4.3.1.2	Use of complete dose of phosphorus (2)	
4.3.1.3	Use of complete dose of potash (2)	
4.3.1.4	Use of partial dose of nitrogen (1)	
4.3.1.5	Use of partial dose of phosphorus (1)	

4.3.1.6	Use of partial dose of potash (1)	
4.3.1.7	Fertilizers not used at all (0)	
4.3.2	Time of application of fertilizer	
4.3.2.1	Use of basal dose only (1)	
4.3.2.2	Use of basal dose and one top dressing (6 weeks after planting) of fertilizer (2)	
4.3.2.3	Use of basal dose and two times top dressing (6 and 10 weeks after planting) of fertilizer (3)	
4.3.2.4	Use of basal dose and three times top dressing (6 weeks, 10 weeks and 14 weeks after planting) (4)	
4.3.3	Method of application of fertilizer	
4.3.3.1	Applying in furrows, opened on either side of crop rows and then covered by soil (2)	
4.3.3.2	Applying on standing water in the field (1)	
4.3.4	Distributing fertilizers to all plots equally :	Yes / No (1) (0)
4.4	Application of micronutrients (only iron deficiency was noticed in sugarcane plots)	
4.4.1	Does your soil has iron deficiency :	Yes / No (0) (2)
4.4.2	If yes, did you apply ferrous sulphate :	Yes / No (1) (0)
4.5	Application of soil amendments	
4.5.1	Is your soil salt affected :	Yes / No (0) (2)
4.5.2	If yes, did you apply any soil amendments : (gypsum/lime)	Yes / No (1) (0)
5.	Water management	
5.1	Irrigating sugarcane in red soil (frequency of irrigation)	
	(a) Once in 5-8 days (3)	
	(b) Once in 8-15 days (2)	
	(c) Once in a month (1)	

- 5.2 Did you follow furrow method of irrigation crop : Yes / No
(1) (0)
- 5.3 Water management practices for soil salt affected :
- 5.3.1 Is your soil salt affected Yes / No
If yes, have you. (0) (2)
- 5.3.1.1 Changed the salt affected water and allowed : Yes / No
fresh water frequently (1) (0)
- 5.3.1.2 Grown salt tolerant variety i.e., Co-62175 Yes / No
(1) (0)
- 5.4 Water management practices under water shortage conditions
- 5.4.1 Have you experienced water shortage condition : Yes / No
If yes, have you. (0) (2)
- 5.4.1.1 Practised trash mulching Yes / No
(1) (0)
- 5.4.1.2 Applied 25 per cent excess potash fertilizers Yes / No
(1) (0)
- 5.5 Water management practices under excess water/water logged condition
- 5.5.1 Have you experienced excess water/water logged Yes / No
condition (0) (2)
If yes, have you :
- 5.5.1.1 Provided diversions drains to drain out excess Yes / No
water (1) (0)
- 5.5.1.2 Grown salt tolerant varieties i.e., Co-62175 Yes / No
(1) (0)
- 6.0 Integrated pest management
- 6.1 Integrated weed management
- 6.1.1 Experienced weed problem in cane fields Yes / No
(0) (2)
- 6.1.1.1 Controlled weeds through cultural methods Yes / No
(hoeing and intercultural operations) (1) (0)
- 6.1.1.2 Controlled weeds by hand weeding Yes / No
(1) (0)

6.1.1.3	Use of herbicides	Yes/ No (1) (0)
6.2	Integrated disease management	
6.2.1	Did you use disease free seed material (setts) for planting	Yes / No (1) (0)
6.2.2	Did you follow hot water treatment of setts before planting	Yes / No (1) (0)
6.2.3	Did you uproot and burn the disease affected yellow clumps	Yes / No (1) (0)
6.2.4	Did you noticed brown leaf spot diseases on sugarcane If yes, did you:	Yes / No (0) (2)
6.2.4.1	Provided good drainage for excess water, so that: your crop is free from leaf spot disease	Yes / No (1) (0)
6.2.4.2	Applied 25 per cent excess potash fertilizers	Yes / No (1) (0)
6.3	Integrated insect management	
6.3.1	Did you noticed termites in sugarcane plot : If yes, did you:	Yes / No (0) (2)
6.3.1.1	Catch the termite queen and destroyed it :	Yes / No (1) (0)
6.3.1.2	Frequently irrigated the crop	Yes / No (1) (0)
6.3.1.3	Control termite by using chemicals :	Yes / No (1) (0)
6.3.2	Did you noticed early shoot borer attack in sugarcane plots? If yes, did you :	Yes / No (0) (2)
6.3.2.1	Practised mulching :	Yes / No (1) (0)
6.3.2.2	Practised earthening-up operation	Yes / No (1) (0)
6.3.2.3	Control through biological method using <u>Tricho-</u> <u>gramma</u> egg parasites	Yes / No

If yes, mention the number of Trichogramma egg parasites and time to release to sugarcane plots.

Batches	Number/acre	Time of release
First	6000 (1)	4th week after planting (1)
Second	6000 (1)	5th week after planting (1)
Third	6000 (1)	6th week after planting (1)
Fourth	6000 (1)	7th week after planting (1)
Fifth	6000 (1)	8th week after planting (1)

7. Ratoon management

7.1 Time of Ratoon done

7.1.1 Practised ratoon from June to November harvested crop (2)

7.1.2 Ratoon done at an inappropriate time (1)

7.2 Did you perform gap filling operation: Yes / No
(1) (0)

7.3 Did you incorporate leaf trash to ratoon field : Yes / No
(1) (0)

7.4 Did you perform stubble shaving operation: Yes / No
(1) (0)

7.5 Did you perform shoulder breaking operation : Yes / No
(1) (0)

7.6 Integrated nutrient management

7.6.1 Application of fym/compost (organic manures)

7.6.1.1 Non adoption (0)

7.6.1.2 Partial adoption of less than 5 tons or 10 cartloads per acre (1)

7.6.1.3 Complete adoption as recommended i.e., 5 tons or 10 cartloads per acre (2)

7.6.2 Application of inorganic manure (Fertilizers)

7.6.2.1 Non adoption (0)

7.6.2.2 Partial adoption of less than recommended (1)

7.6.2.3 Complete adoption as recommended (2)

7.7 Did you follow the same time of application of fertilizer :Yes / No
in ratoon crop, as followed in the case of first/main crop (1) (0)

7.8 Did you follow the same method of application of fertilizer:Yes / No
in ratoon crop, as followed in the case of first/main crop (1) (0)

7.9 Did you distributed fertilizer to all plots equally. Yes / No
(1) (0)

8. Maturity and Harvesting

8.1 Did you judge the maturity of sugarcane crop Yes / No
for timely harvest (Any method followed among the (1) (0)
three mentioned methods carry one score)

8.1.1 Judging maturity by experience

8.1.2 Judging maturity by trial boiling of juice for gaggery preparation

8.1.3 Judging maturity by examining sucrose content in the juice.

8.2 Did you harvested the crop when it is matured: Yes / No
(1) (0)

8.3 Did you cut the canes at ground level to get optimum Yes / No
yield: (1) (0)

III. Independent variables

A. Personal Factors

1. Age

Age of the respondent : _____ years

2. Education

2.1 Illiterate : _____

2.2 Functional literates : _____

2.3 Primary school : _____

- 2.4 Middle school : _____
- 2.5 High school : _____
- 2.6 Pre-University : _____
- 2.7 Graduates/Diploma : _____

3. Socio-economic status

3.1 Occupation

(i) None	(iv) Skilled
(ii) Unskilled	(v) Farming/Business
(iii) Semi-skilled	(vi) Professional

3.2 Land holdings

- (i) Landless (ii) Marginal (iii) Small (iv) Big

3.3 Annual income

(i) Less than 20,000	(iv) 60,000 to 80,000
(ii) 20,000 to 40,000	(v) 80,000 to 1,00,000
(iii) 40,000 to 60,000	(vi) More than one lakh

3.4 House

(i) Thatched	(iv) Concrete house
(ii) Mudwalled thatched	(v) Concrete double storied
(iii) Brick wall tiled	

3.5 Possession

- (i) None
- (ii) One farm animal/bullock/buffalo/cycle/furniture
- (iii) Two farm animal/bullock cart
- (iv) Three to four farm animal/improved farm implement/
Newspapers/electricity
- (v) 5-10 farm animals/Gobergas/pumpset/bike
- (vi) More than 10 animals/tractor/automobile

B. Behavioural Factors

4 Knowledge about sustainable sugarcane farming technologies

4.1 Land preparation

4.1.1. Ploughing the land using tractor will reduce soil compaction. Yes / No

4.2 Seed (setts) and sowing

4.2.1. Setts from main/first crop should be used for planting: Yes / No

4.2.2 Quantity of setts to be used per acre : _____

4.2.3 Recommended spacing for sugarcane crop : _____

4.3 Sugarcane based cropping system

4.3.1. For better soil fertility sugarcane : (a) Sugarcane
should be rotated with (b) Cereals
(c) Legumes

4.3.2. Growing of legume as an intercrop with sugarcane enriches: Yes / No
soil and supplements income.

4.4 Integrated nutrient management

4.4.1. Amount of fym/compost to be : (a) 15-25 tonnes
used per acre (b) 5-14 tonnes
(c) Less than 5 tonnes

4.4.2. Time of application of FYM _____ weeks before planting

4.4.3. Name any one type of biofertilizer : _____
used in sugarcane crop

4.4.4. Recommended quantity of fertilizers : (a) 100:40:50
to be used for cane in acre (kgs of NPK) (b) 50:20:10
(c) 100:75:200

4.5 Water management

- 4.5.1. Frequency of irrigation to sugarcane : (a) Once in 6-8 days
in red soils (b) Once in 9-15 days
(c) Once in a month
- 4.5.2. Name any one salt resistant variety : _____
of sugarcane.
- 4.5.3. By practising mulching one can conserve moisture Yes / No

4.6 Integrated pest management

- 4.6.1. Frequently irrigating the crop will help in control
of termites in sugarcane Yes / No
- 4.6.2. Trichogramma egg parasites will help in controlling
early shoot borer Yes / No
- 4.6.3. Number of Trichogramma egg parasites to be released
per acre to control early shoot borer.
- (a) 30,000 to 25,000
 - (b) 24,999 to 20,000
 - (c) Less than 20,000
 - (d) Not used

4.7 Ratoon management

- 4.7.1. Is stubble shaving a necessary operation in practising
ratoon: Yes / No
- 4.7.2. Ratoon crop does not require the same amount of nutrients
as that of main/first crop Yes / No
- 4.7.3. For getting good ratoon crop the main crop should be (a) June-Sept.
harvested in the months (b) Nov.-Feb.
(c) March-May

4.8 Maturity and Harvest

- 4.8.1. Timely harvest is not required for getting more sugar
recovery from cane Yes / No
- 4.8.2. Harvesting the cane at ground level is not required
to get good yield Yes / No

5. Attitude towards sustainable farming

Please indicate the choice among five alternatives
(SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree,
SD = Strongly Disagree)

Sl. No.	Statements	Responses categories				
		SA	A	N	D	SD
5.1	Sugarcane farming should be done as to maximise profits even if it threatens long term productivity of land					
5.2	Large quantity of inputs should be used in sugarcane farming as long as it is profitable					
5.3	The primary goal of farmers should be to improve quality of products produced in their farms					
5.4	Good sugarcane farming demands personal experience and better knowledge on the land					
5.5	Agricultural Scientists and Policy makers should recognise that there are limitations to what nature can provide and adjust their expectations accordingly					
5.6	Healthy rural communities are essential to make the sugarcane farming a success					
5.7	Farm traditions and culture are of little use in modern sugarcane farming					
5.8	Farming is first of all a way of life and then a business					
5.9	Farmers should use primarily synthetic fertilizers and pesticides in order to maintain adequate levels of production					
5.10	Most farmers should specialise either in livestock or crops					
5.11	Modern farming is a major cause of ecological problems and must be greatly modified to become ecologically sound					

Sl. No.	Statements	Responses categories				
		SA	A	N	D	SD
5.12	Crop rotations and diversifications are not essential for successful farming					
5.13	Farmers should produce as many of their own goods and services					
5.14	Soil and water are basic factors of production and should be exploited for larger production					
5.15	The key to initiate successful farming lies in learning to imitate natural ecosystem and practise farming in harmony with nature					
5.16	Farm labour should be replaced whenever possible by more efficient machines					
5.17	Processing and marketing of the produce is best done at local and regional level					
5.18	The abundance of the production is an indicator of correct way of farming					

C. Motivational Factors

6. Management orientation

Please indicate your agreement or disagreement about each of the following statements.

Sl. No.	Statement	Response category	
		Agree	Disagree
6.1 Planning			
6.1.1	Each year one should think afresh about the crop to be cultivated in each type of land		
6.1.2	It is not necessary to make prior decisions about the variety of crop to be cultivated in the land		
6.1.3	The amount of agricultural input like seed, organic manures etc., needed for raising a crop should be assessed before cultivation		
6.1.4	It is not necessary to think a least of the cost involved in raising a crop		
6.1.5	One need not consult an agricultural expert for crop planning		
6.1.6	It is possible to increase the yield through farm production plan		
6.2 Production			
6.2.1	Timely planning of crops ensures good yield		
6.2.2	Determining nutrient analysis by soil testing saves no money		
6.2.3	One should use as much as fertilizer as he likes		
6.2.4	Seed (sett) rate should be given as recommended by specialists		
6.2.5	For timely harvest one should analyse the maturity of crop		
6.2.6	With high water rate one should use as much irrigation water as available		

Sl. No.	Statement	Response category	
		Agree	Disagree

6.3 Market

- 6.3.1 Market news is not so useful to farmer
- 6.3.2 A farmer can get good price by grading his produce
- 6.3.3 One should sell his produce to the nearest sugar factory irrespective of price
- 6.3.4 One should purchase the inputs from the shop where his other relatives purchase
- 6.3.5 One should grow those crops which have no market demand
- 6.3.6 One should sell the produce through middle man

7. Risk orientation

There are 5 statements given below indicate whether you agree or disagree with these statements.

Sl. No.	Statement	Response category	
		Agree	Disagree

- 7.1. An agriculturist should rather take more chance in making a big profit than to be content with a smaller, but less risky profits
- 7.2. An agriculturist who is willing to take greater risks than the average agriculturist usually does better financially
- 7.3. It is good for an agriculturist to take risk when he knows his chances to success is fairly high
- 7.4. It is better for an agriculturist not to try new methods/techniques unless most other have used them with success
- 7.5. Trying an entirely new methods in agriculture involves risk, but it is worth

8. Scientific orientation

Please indicate your choice among three alternatives for each of the following statements.

Sl. No.	Statement	Response		
		Agree	Undeci- ded	Dis- agree
8.1	New methods of farming gives better results to a farmer than the old method			
8.2	The way farmer's fore-fathers practised agriculture is still the best way even today			
8.3	Even a farmer with lot of experience should use new method in agriculture			
8.4	Though it takes time for a farmer to learn new methods in agriculture, it is worth the efforts			
8.5	A good farmer experiments with new ideas in agriculture			
8.6	Traditional methods in farming have to be changed in order to raise the level of living of a farmer			

9. Economic motivation

Indicate whether you agree or disagree with the following statements

Sl. No.	Statement	Response	
		Agree	Disagree
9.1	A farmer should work towards large yields and economic profits		
9.2	The most successful farmer is one who makes most profit		
9.3	A farmer should try any new farming idea which may earn him more money		
9.4	A farmer should grow cash crops to increase monetary profits in comparison to growing of food crops for home consumption		
9.5	It is difficult for the farmer's children to make good start unless he provides him with economic assistance		
9.6	A farmer must earn his living but the most important thing cannot be defined in economic terms		

10. Value orientation

State whether you agree or disagree with the following statements

Sl. No.	Statement	Response	
		Agree	Disagree
10.1	God's blessing is the most important condition necessary for a good crop		
10.2	A farmer should not be sentimental in selling away old cattle		
10.3	It is below the dignity of a person of good social standing to engage in activities such as raising poultry even though they can be profitable		
10.4	It is below the status of a woman belonging to a respectable family to work as labourer in another man's farm		
10.5	As pig is a dirty animal, a person belonging to a higher caste should not rear it		
10.6	In cultivating different crops one's attempt should be to meet the requirements of one's family only		
10.7	Only those persons whose occupation by tradition is the keeping of animals would succeed in dairy		
10.8	It is below the dignity of an educated youth to plough fields		
10.9	One should try to start important agricultural works during auspicious periods		
10.10	It is due to the displeasure of god on human beings that it does not rain regularly on some occasions		

11. Achievement orientation

Tick any one of the alternatives given under each statements :

- 11.1 Success brings relief for further determinatin and not just pleasant feelings

Strongly agree / Agree / Undecided / Disagree / Strongly disagree

- 11.2 How true it is to say that your efforts are directed towards a goal?

Quite natural / Not very true / Not sure / Fairly true / Quite true

- 11.3 How often do you seek opportunity to excel?

Hardly ever / Seldom / About half the time / Frequently / Nearly always

- 11.4 How many situations do you avoid in which you may be exposed to evaluation?

Hardly ever / Seldom / About half the time / Frequently / Nearly always

- 11.5 Would you hesitate to undertake something that might leads to failing.

Hardly ever / Seldom / About half the time / Frequently / Nearly always

- 11.6 In how many spheres do you think you will succeed in doing as well as you can.

Most / Many / Some / Few / Very few

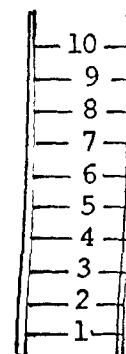
12. Level of aspiration

You see the picture of ladder with 10 steps, suppose we say that top of the ladder represents the best possible life for you and bottom represents the worst possible life for you.

- 12.1 Where on the ladder do you feel personally stand at present?
Step No. _____

- 12.2 Where on the ladder do you feel personally stood five years back?
Step No. _____

- 12.3 Where do you think you will be five years from now?
Step No. _____



13. Innovativeness

Here are eight statements. You may please go through each statement and indicate your response.

Sl. No.	Statement	Response		
		Agree	Undeci- ded	Dis- agree
13.1	Do you want to learn new ways on farm?			
13.2	If the agricultural extension worker gives a talk on improved cultivation aspects, would you attend?			
13.3	If the government would help you establish a farm elsewhere would you move?			
13.4	Do you want to change in your way of life?			
13.5	A farmer should try to farm the the way his parents did.			
13.6	Do you want your sons to be farmers?			
13.7	It is better to enjoy today and lot tomorrow takes care of itself			
13.8	A man's fortune is in the hands of god			

14. Deferred gratification

How would you like to spend your income from farming this year.

Sl. No.	Statement	Response	
		Yes	No
14.1	Family expenses or consumption on food, clothes, furniture, repairs or any addition to home etc.		
14.2	Social obligation, wedding, birthrite, feast, etc.		
14.3	Payoff debts		
14.4	Saving without any idea		
14.5	Purchase or save to purchase land		
14.6	Purchase or save money to purchase agricultural inputs		
14.7	Invest or save money to invest in non-agricultural business		
14.8	Education		

15. Cosmopolitaness

Please indicate how many times you are visiting to your nearest town/city

Sl. No.	Number of times	Purpose of the visit		
		All visits relating to agriculture	Some relating to agriculture	Other purpose
15.1	Two or more time per week			
15.2	Only once a week			
15.3	Once in 15 days			
15.4	Once in a month			
15.5	Very rare			
15.6	Never			

16. Social participation

Please indicate the participation in organisation

Sl. No.	Organisation	Position		Participation in meetings		
		Member	Office bearer	Never	Occasionally	Regular
16.1	Zilla Parishat					
16.2	Mandal Panchayat					
16.3	Land development banks					
16.4	Youth clubs					
16.5	Service Co-operative Society					
16.6	Raitha Sangha (Farmers organization)					
16.7	Others					

D. Situational Factors

17. Family size

	Male	Female	Children	Total
17.1 Number of members : in a family	_____	_____	_____	_____

(Children below 12 years and above 70 years adult are not considered)

18. Farm size

Type of land	Owned		Leased in		Leased out	
	Areas	Guntas	Areas	Guntas	Areas	Guntas
18.1 Dry						
18.2 Wet						
18.3 Garden						

19. Experience in sugarcane cultivation : _____ years

20. Herd size

20.1 Number of animals possessed by the farmers

Type	Number
20.1.1 All types of cows and buffaloes	
20.1.2 Pig, sheep, goat	
20.1.3 Poultry birds	

21. Self reliance

Please tell how much your future you feel depends on yourself?
Out of 100, would you say 100, 75, 50, 25 or nothing

22. Input self-sufficiency

Give details about the quantity of inputs used and the value of those inputs used this year for sugarcane cultivation.

Sl. No.	Inputs used	Own sources		Purchased	
		Quantity	Value	Quantity	Value
22.1	Seeds (setts)				
22.2	Organic manures				
22.2.1	fym/compost				
22.2.2	Green manure				
22.2.3	Bio-fertilizer				
22.2.4	Pressmud				
22.3	Fertilizer				
22.4	Chemicals				
22.5	Human labour				
22.6	Animal labour				
22.7	Machinery power				
22.8	Equipments				
22.9	Trichogramma egg parasites				
22.10	Others				
Total					

23. Farm mechanization

Please indicate the following implements possessed and used by you.

Sl. No.	Implements	Number possessed

23.1	Wooden plough	
23.2	Iron plough	
23.3	Disc plough	
23.4	Cultivator	
23.5	Junior hoe	
23.6	Bund former	
23.7	Sprayers	
23.8	Duster	
23.9	Power tiller	
23.10	Tractor	
23.11	Trailor	

24. **Farming commitment** : Choose any one among five alternatives for each statement (SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree and SD = Strongly Disagree)

Sl. No.	Statements	Response categories				
		SA	A	N	D	SD
24.1	If I were given a job in city, I will quit sugarcane farming					
24.2	I feel that people simply talk of farming problems, they foreget that everything on how they manage it.					
24.3	I am willing to take a great deal of effort to develop my farm					
24.4	I am prepared to face any problems to stay permanently in sugarcane farming					
24.5	I wish my children to be government employees rather than a cane grower like me					
24.6	There is not much to be gained by sticking to sugarcane farming permanently					
24.7	I believe that sugarcane cultivation pays in long run					
24.8	For me sugarcane growing is the best occupation when compared to other occupations					

25. **Land productivity**

Could you please recall the total quantity of sugarcane produced on your farm from the past three crops.

Crops	Area under cane (acres)	Yield (tons/acre)
25.1 Previous crop		
25.2 Second previous crop		
25.3 Third previous crop		

Total		

E. Extension Factors

26. Mass media use : Please choose any one among three alternatives.

Sl. No.	Mass media	Response		
		Regular	Occasional	Never
26.1	Newspaper			
26.2	Radio			
26.3	Television			
26.4	Krishi vignana			
26.5	Krishi loka			
26.6	Leaflets			
26.7	Besaya varthe			

27. Extension agency contact

Sl. No.	Designation	Awareness		Frequency of contact			Purpose	
		Aware	Not aware	Never	Some- times	Regu- lar	Cas- ual	To seek technical guidance
27.1	Director of Agriculture							
27.2	Joint Director of Agriculture							
27.3	Principal Agricul- tural Officer							
27.4	Assistant Director of Agriculture							
27.5	Subject Matter Specialist							
27.6	Agricultural Officer							
27.7	Assistant Agril. Officer							
27.8	Agril. Assistant							
27.9	UAS Specialist							
27.10	Cane Superintendent							
27.11	Cane Development Officer/Supervisors							

28. Farm scientist contact : (Farm scientists include scientists from Agricultural University and other Research Institutes).

28.1 Awareness of farm scientist : Aware / Not aware

28.2 Frequency of contact : Never / Sometimes / Regular

28.3 Purpose of visit : Casual/Toget technical guidance

29. Participation in training programme

(During last three years training programme attended on agriculture and allied subjects)

Sl. No.	Number of times attended	Duration of training		
		One day	2-4 days	5 days and above
29.1	Participated once			
29.2	Participated twice			
29.3	Participated thrice			

30. Extension participation

Please indicate the participation involvement in the extension activity and the frequency of contact since four months.

Sl. No.	Extension activity	Pattern of participation		
		Regularly	Occasional	Never
30.1	Krishimela			
30.2	Demonstration			
30.3	Training programme			
30.4	Group meetings			
30.5	Field days			
30.6	Field visits			

IV. Components contributing to sustainable sugarcane farming as perceived by farmers

Sl. No.	Reasons	Response category	
		Yes	No
1.	Use of farm yard manure/compost		
2.	Use of biofertilizers		
3.	Use of press mud		
4.	Use of soil amendments		
5.	Adoption of hot water treatment for setts		
6.	Adoption of crop rotation		
7.	Adoption of intercropping		
8.	Use of micronutrients		
9.	Application of crop residues		
10.	Balanced fertilizer application		
11.	Non-dependency on chemical pesticide		
12.	Non-dependency on farm power		
13.	Good knowledge on sustainable sugarcane farming practices		
14.	Received technical guidance on sustainable sugarcane farming practices		
15.	Proper water management practices before, during and after fertilizer application		
16.	Release of <u>Trichogramma</u> egg parasites to control early shoot borer		
17.	Adoption of salt tolerant variety		
18.			
19.			
20.			