A STUDY ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION IN VISAKHAPATNAM DISTRICT OF A.P.

BY

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M Sc (Ag.)

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CERTIFICATE

Mr. G. SOWJANYA ROY, has satisfactorily prosecuted the course of research and that the thesis entitled **"A STUDY ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION IN VISAKHAPATNAM DISTRICT OF A.P."** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any university.

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CERTIFICATE

This is to certify that the thesis entitled **"A STUDY ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION IN VISAKHAPATNAM DISTRICT OF A.P."** submitted in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE** of the Acharya N.G. Ranga Agricultural University, Hyderabad is a record of the bonafide research work carried out by **Mr. G. SOWJANYA ROY** under my guidance and supervision. The subject of the thesis has been approved by the Students Advisory Committee.

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

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I, **G. SOWJANYA ROY**, hereby declare that the thesis entitled **"A STUDY ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION IN VISAKHAPATNAM DISTRICT OF A.P."** submitted to the Acharya N.G. Ranga Agricultural University for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE** is a result of original research work done by me. I also declare that any material contained in the thesis has not been published earlier in any manner.

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ABSTRACT

The present study was conducted following ex-post-facto research design and random sampling taking 120 rainfed and 120 irrigated farmers to arrive a total of 240 sugarcane farmers from Visakhaptanam district of Andhra Pradesh. The data were collected by interview method through structured pre-tested interview schedule. Twenty five researchers of RARS, Anakapalle were selected for the study. Thirty extensionists from sugar factories and department of agriculture were selected by employing proportionate stratified random sampling method. The data were collected from researchers and extensionists through questionnaire. Sixteen independent variables namely; education, sugarcane cultivation experience, trainings received, achievement motivation, attitude towards sustainable farming, economic orientation, level of aspiration, farming commitment, scientific orientation, decision making pattern, farm size, family educational level, sugarcane cultivation intensity, socio-economic status, extension system link and research system link and one dependent variable i.e., sustainability of sugarcane cultivation were included in the study. Statistical tests like frequency, percentage, arithmetic mean, standard deviation, correlation, multiple linear regression and step down regression were employed to analyse and interpret the data.

Majority of the farmers had middle school education. Majority of the farmers were above 20 years of sugarcane cultivation experience, majority of the farmers had medium level of training received, achievement motivation, economic orientation, level of aspiration, farming commitment, scientific orientation, decision making pattern, family educational level, sugarcane cultivation intensity, socio-economic status, extension system link and research system link. Majority of the farmers had favourable attitude towards sustainable farming. Majority of the farmers had 2.5 to 5 acres of farm size.

Majority (65.84%) of the farmers comprising of both rainfed and irrigated belonged to medium level of sustainability group.

Majority of farmers had medium level with respect to soil environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

Majority of the rainfed farmers had medium level with respect to soil environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

Majority of the irrigated farmers had medium level with respect to soil environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

The independent variables of the farmers viz., education, sugarcane cultivation experience, training received, achievement motivation, attitude towards sustainable farming, economic orientation, farming commitment, decision making pattern, farm size, family educational level, socio economic status, extension system link and research system link had positive and significant relationship with sustainability of sugarcane cultivation.

All the independent variables put together explained the variation in sustainability of sugarcane cultivation to the extent of 62.00 per cent.

Lack of facilities for sett treatment for the control of smut and grassy shoot diseases, inadequate availability of organic manure, lack of timely training on sustainable sugarcane farming practices, inadequate availability of credit were perceived as major problems in situational, input supply and services, technical and financial aspects respectively as perceived by farmers. Whereas, sugar factory should provide facilities for sett treatment, was the major suggestion as given by farmers.

Inadequate supply of irrigation water from canals, untimely supply of inputs and lab chemicals, identification of early maturing varieties (with high sucrose content) for quality returns under different months of planning and harvesting, no crop insurance for sugarcane crop in situational, input supply and services, technical and financial aspects respectively were perceived as major problems by researchers, whereas, adopting drip irrigation was the major suggestions given by the researchers.

Non-adoption of recommended agronomic practices like fertilization and irrigation, non-treatment of setts, indiscriminate use of fertilizers are the major problems as perceived by the extensionists.

Sett material should be supplied through sugar factories, crop insurance should be implemented and steps should be initiated for continuous power supply are the major suggestions given by the extensionists.

Chapter - I

Introduction

CHAPTER – I

INTRODUCTION

" --- there is enough on this earth for the need of every man but not for the greed of all". ***- Mohandas Karamchand Gandhi***

Sustainable development means improving the quality of human life while living within the carrying capacity of the earth's finite resources. Agricultural development is sustainable if it assures that the productive capacity of the agricultural sector will be sufficient to meet current and future needs.

Sustainable agriculture requires attention to resource conserving technologies and practices, local groups and institutions and external organizations working in partnership with local people believing sustainability in agricultural production and conservation of natural resources are considered to be topics of major concern among the scientific community. Sustainable agriculture is not new to Indian farmers, because the farming practices by our farmer for centuries was 'Sustainable Agriculture'.

Everyone expects development without destruction, but unfortunately very often it happens the other way. 'Agriculture' as practiced in the recent 4-5 decades is considered as a serious polluter of environment. In the anxiety of increasing food production for ever increasing population of the country during the past 50 years, least attention had been given to production environment. This kind of agriculture is associated with decline in soil productivity, deterioration of the environmental quality, reduced profitability and ultimately threatening the human and animal health.

The goal of sustainable agriculture is to feed growing population, while farming in an ecologically sound regenerative way. Economically viable systems that minimize the proportion of farm inputs such as pesticides and fertilizers are rely on on-farm renewable resources form the crux of sustainable agriculture. Farming methods that emphasize soil building practices (like incorporation of crop residues, animal manure, green manure etc.,) natural pest control methods, crop rotation with nitrogen fixing legumes, crop diversity all constitute systems that ensure substitution of external resources by internal resource, reduce production costs and are ecologically sound.

Mehta (1995) 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 once from monoculture to multiculture 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 crop and green manure.
5. Synthetic substances like chemical fertilizers, hazardous pesticides, weedicides should be minimized and
6. The IPM (Integrated Pest Management) involves growing disease resistant varieties and biological control, such as natural predators or parasites that keep the pest population below injurious levels.

1.1 STATEMENT OF THE PROBLEM

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 tonnes/ha) is stagnant for the last three years and is far below compared to the productivity (140-150 tonnes/ha) of under developed South African countries like Ethiopia, Kenya, Tanzania and Zimbabwe.

Sugarcane is a very exhaustive crop in order to boost production, farmers use more of fertilizers, pesticides, weedicides and water in large quantities. Hence ,sustainable sugarcane cultivation is the only way in order to sustain yields without compromising environmental pollution. However there were very few studies conducted on sugarcane sustainability in different districts of the Andhra pradesh and some districts were leftout. Hence, sustainabilty of sugarcane cultivation is studied in the present investigation in visakhapatnam district. .

By the above considerations, the present study entitled "A study on the sustainability of sugarcane cultivation in Visakhapatnam district of A.P." was conceived and planned with the following objectives.

1. To find out the personal, situational, psychological and communication factors of sugarcane farmers
2. To develop an index to measure the sustainability of sugarcane cultivation
3. To measure the sustainability of sugarcane cultivation in rainfed and irrigated conditions
4. To ascertain the ccntribution of personal, situational, psychological and communication factors of farmers responsible for sustainability of sugarcane cultivation

5. To analyse the problems and suggestions as perceived by farmers, researchers and extensionists
6. To suggest a suitable strategy to make sugarcane cultivation more sustainable.

1.2 SCOPE OF THE STUDY

1. The study would be great help to identify the different sustainable sugarcane farming practices. In the process, the reasons for low sustainability could be analysed and necessary corrective measures can be suggested to overcome those lacunae.
2. 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 these factors while educating sugarcane farmers.
3. This study would be of great importance to the agricultural department for planning future programmes with respect to sustainable sugarcane farming practices. It will also be useful to the researchers so that they can analyse the constraints of farmers and redesign the research to evolve sustainable sugarcane farming practices and give them useful and practically applicable solutions to follow these practices in future.

1.3 LIMITATIONS OF THE STUDY

The study has the following general limitations.

1. Being a single student investigation, the study has the usual limitation of time, resources and finance.
2. The study was based on the expressed opinions of the respondents which may not be free from their individual subjective perception and bias, inspite of the efforts to get them as objectively as possible.
3. The implications of the findings of the study could be limited to the similar crops only.

1.4 PRESENTATION OF THE STUDY

The report of the study is presented in six chapters. The first chapter deals with brief introduction including need and importance, objectives and limitations of the study. A brief review of literature relevant to the problem and objectives is presented in the second chapter. The third chapter is devoted to the materials and methods followed with statistical procedures used, results are presented with respect to objectives of the study in chapter four. The fifth chapter deals with discussion based on results of the study. Finally, the sixth chapter deals with summary, implications and suggestions for future research. Literature cited and appendices are given at the send.

Chapter - II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

Past studies pave way for future research endeavor. An acquaintance with earlier pertinent studies has been necessary for better understanding of the present study and to develop appropriate research methodology. After thorough reviewing of all the possible sources it may be observed that the relevant studies were limitedly attempted so far and the findings on such studies are scarce too. However, an attempt has been made to orient much on the theoretical views of different authors on the subject and the closely related results were reported due to lack of pertinent reviews. Keeping in view the objectives of the study, the review of the available literature which had meaningful reality to the study is presented under the following heads:

DEPENDENT VARIABLE

2.1 Concept of sustainable agriculture

2.2 Components of sustainability

INDEPENDENT VARIABLES

2.3 Personal characteristics

2.4 Relationship between variables

2.5 Conceptual framework

2.6 Hypothesis

DEPENDENT VARIABLE

2.1 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. The sustainable agriculture movement evolved from several reform movements in USA, Canada and Western Europe that developed in response to concerns about impact of indiscriminate use of agricultural chemicals.

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

In India, green revolution started in the sixties with the introduction of high yielding varieties and input intensive agriculture helped to achieve the goal of targeted food production which became conspicuous by 1980. Further, the indiscriminate use of inputs (chemical pesticides and fertilizers) has caused serious environmental problems in well endowed regions like Haryana and Punjab due to the instability and fluctuations in productivity. Since, the then the scientists of our country are making efforts to evolve certain technologies in agriculture which are low cost and ecologically safe besides maximizing productivity in long-run.

Sustainable agriculture has emerged as the most agreed upon term to synthesize a variety of concepts and prospective associated with agricultural

practices that differ from these of conventional production. The use and measurement of this concept has recent origin and become buzzword for agricultural programmes in education, extension, research and government policy to take stock of effects on natural sources. The concept clarification has been expressed in many ways by many scientists in different situations as presented hereunder.

It was generalized that a sustainable agriculture package for each agree will have to be developed jointly with the total community since practices which are not socially compatible will not be acceptable. This is where the social engineering aspects of technology development and dissemination require attention (Anonymous, 1991).

Mackay (1991) felt that determining indicators of existing farming systems at field level is very important. One such indicator is system diversity.

Jodha (1991) treats sustainability as characteristic feature of the agricultural system. Sustainability is the ability of the system to maintain a certain well defined level of performance, over time, and if required to enhance the same through linkages with the systems without damaging the ecological integrity of the system.

Sustainable agriculture can be defined as the management and conservation of the resource 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 socially acceptable (FAO, 1991).

According to Venkataramani (1991) sustainable agriculture is that form of farming which produces sufficient food to meet the needs of the present generation without eroding the ecological assets and the productivity of the life supporting system of future generations.

Board for International Food and Agricultural Development and Economic Co-operation (BIFADEC, 1991) opined "Sustainable agriculture is not a technique to be precisely defined, but a concept common to most environmentally based economic activities. Simply, it is that continued production depends upon maintenance of the resources on which production is based".

Harrington (1992) concluded that sustainability and sustainable agricultural development could be interpreted in terms of agro-ecology, equity and sustainable growth.

Lefroy and Hobbs (1992) found that water cycle, nutrient cycle, energy and diversity are the ecological parameters for the assessment of land use on farms in the wheat belt of Western Australia.

Gradwohl and Greenberg (1992) has explained sustainable system as "To be sustainable, an agriculture system must maintain crop production overtime. Whether plots are permanent or shifting, they must provide adequate nutrition for crops, afford some protection against weeds and pests and be able to withstand fluctuations in environmental conditions. Social and economic conditions in

subsistence agriculture may preclude a reliance upon costly or dangerous supplements such as expensive equipment, commercial fertilizers and pesticides".

Dunlop *et al.* (1992) in their effort to arrive at a comprehensive definition of sustainable agriculture based on indicators, subjected 14 dimensions to faculty judgment. Among them, nine dimensions viz., protect and enhance soil, ensure supply of safe and whole food, improve site specific knowledge of farmers, enhance environment and wild life habitat, increased diversity, improved farm economy, reduced agri-chemical use, reduced energy use and reduced purchase of inputs have been considered as most important in explaining the concept of sustainable agriculture.

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.

Reijntjes *et al.* (1992) remarked that agriculture is sustainable, if it is ecologically sound, economically viable, socially ust, humane and adaptable. Further they opined that objectives of any household are productivity (output / unit of land and input used), security (minimizing risk of production). Continuity (maintaining soil and water health) and identity (self respect, social justness and humaneness). Feeling of identity is maintained by technologies that permit to be self reliant and to control decision making about use of local resources and products.

Pookpakdi (1993) opined that a sustainable production system should be directed towards three essential goals namely food security, employment and income generation and natural resource conservation and environment protection.

Jones (1993) defined sustainable agriculture in the context of developing countries. It is maintaining food production or increase that trend while preserving or enhancing the underlying resource base and minimizing wherever possible the dependence on external inputs.

Third annual report (Anonymous, 1993) of M.S. Swaminathan research foundation details the procedure for measuring sustainable living standard index (SLSI) at household level. The SLSI of an household at a given point of time was measured in terms of income status, asset ownership status, food and nutrition status and educational status.

Garforth (1993) observed that a farming system is sustainable if the inputs required are always available and if those components of the physical environment on which the system depends remain undamaged.

Van den Ban (1993) was of the view that, for sustainable agriculture, indigenous knowledge and competence that enable farmers to depend upon their own ability to take decisions is one of the very important pre-conditions.

Nadkarni (1993) observed that the sustainable development has observable indicators like (i) productivity (yield or net income), (ii) stability of yield or net income, (iii) sustainability of yield and net income and (iv) equitability in terms of income distribution.

Shrivastava (1994) suggested the strategies for sustainable development like suitable alternatives beneficial to the ecology of the area through conserve soil and water, increase productivity, improve quality of life and check environmental crisis.

Mendoza (1994) expressed that any agricultural system to be identified as sustainable one must achieve most, if not all, of the following objectives:

- increased productivity, profitability and economic well being of farmers
- preservation of environmental quality
- self-sufficiency for food
- equitable distribution of economic returns
- optimal utilization of internal resources produced on farm.

Jayasree and Prasad (1994) analysed different dimensions of sustainable agriculture and identified 12 possible dimensions which included Technological appropriability, Economic feasibility, Environmental soundness, Temporal stability, Resource use efficiency, Local adaptability, Social acceptability, Political tacitness, Administrative manageability, Cultural credibility and renewability.

Most agreed definition of sustainable agriculture is the appropriate use of crop and livestock system and the agricultural inputs supporting their activities which maintain economic and social viability while preserving the high productivity and quality of the land (Hoods and Gupta, 1995).

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

Santhi and Ponnuswamy (1995) stated that integrated farming system approach is a viable one to meet the needs of ever increasing population and for better standard of living. Additional labour generation, stable and well-distributed income throughout the year, recycling of farm waste and animal waste are effectively done by integrating cropping enterprise with animal enerprise.

Katar (1995) found that sustainability is defined as the ability of a renewable natural resource system to produce a socially optimum level of output in perpetuity with no detrimental effects on the resource system itself or the physical environment.

Gowda (1996) indicated that nutrient management, water management, integrated pest management, crop yield security, information self-reliancy, input-self sufficiency, family food self-sufficiently, land productivity and input productivity are some of the important indicators of sustainability of agriculture.

Panigrahi and Saranghi (1996) found that successful adoption of alternative farming systems had resulted in sustained economic and environmental benefits.

Chandregowda (1996) defined sustainability of rice farming as the process by which the farmers manage soil and water relying mainly on farm resources to enhance the productivity and maintain it to meet farm and family needs without effecting the production environment.

Vijaya (1996) revealed that sustainable agriculture can be referred to as alternative farming or conservation farming or regenerative agriculture or organic farming for accepting the principle of co-existence of social microbes, livestock and tree component which leads to natural farming for future prosperity.

Agarwal (1997) stated that eco-sustainable agriculture is linked to carrying capacity of the ecosystem based on the development planning process by analyzing the underlying co-relationship between population poverty and pollution to provide supportive capacity for development and assimilative capacity for maintenance of acceptable quality of environment.

Satapathy and Das (1997) stated that specific pin pointed stimulating extension methods which can be used as per the clients brings sustainability in agriculture. The main drive to development of good human beings along with good farmers. This will help us to create eco-friendly situation leading to sustainable agriculture which will encompass stability, productivity and equity.

Verma and Agarwal (1997) revealed that economics of sustainable development is the development that lasts. It means meeting the need of the present without compromising the ability of future generation to meet their needs.

Lakshminaryana (1997) defined sustainability of sugarcane farming as the degree to which the farmers manage soil and water relying mainly on 'on

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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.

In less than half a century, use of chemical fertilizers in iron, increased from five tonnes to 1.7 million tonnes.

Nagabhushanam (1997) found that over a half of the respondents belonged to medium sustainability group (57.78%) whereas an equal percentage of farmers i.e., 21.67 per cent and 20.55 per cent belonged to low and medium level of sustainability groups, respectively.

Basavaraj and Patil (1997) stated that sustainable crop production not only involves identification and application of improved technology but also sustainable management of natural and renewable resources and maintaining the quality of environment and conserving the natural resources, soil water on a long-term basis.

Gurava Reddy (1998) stated that sustainable agricultural practices which pressure or enhance the natural resource base, environmental quality and satisfy the present needs without jeopardizing the future potential.

Subbarao (1999) reported the Rio-declaration (1992) emphasized four cardinal principles most relevant to sustainable agriculture as follows:

- Human beings are the centre of concern for sustainable development and environmental issues are best handled with the participate co-operation of all concerned.

- No development can be considered complete unless it meets the criteria of productivity, equity and environmental safety for the present and future generations.
- To ensure development and sustainability it is necessary to remove all negative factors leading to unsustainability.
- Environmental policies must form an integral part of development polices and strategies.

Teng (1999) found that sustainable agricultural development must satisfy the criteria of economic viability, ecological soundness and social equity, and would generally have to be practiced in the context of conservation of biodiversity, the balancing of present with future needs, a renewal of the natural resource base, and the augmentation of indigenous knowledge.

Singh *et al.* (2000) stated that the concept of sustainability lies in maintaining harmony between buoyancy and dynamism in agricultural growth for meeting basic human needs along with emphasis on protection and conservation of natural resources.

Amudhasurabi and Vasanthakumar (2001) emphasized that the basic challenge for sustainable agriculture is to make better use of internal resources by ultimate minimization of external inputs. To have a sustainable agricultural system, the farmers should be made to realize the use of resource conserving and utilization principles of organic farming, IPM, soil and water conservation, nutrient recycling, multiple cropping and waste utilization.

Kumaraswamy (2001) enumerated the principles of sustainable agriculture as follows:

1) High yielding and high quality varieties of crops must be chosen and grown

2) Improved agronomic practices from land preparation to efficient harvest technology must be adopted

3) Integrated soil fertility management practices to improve the physical, chemical and biological properties of the soil using organic manures, fertilizers and bio-fertilizers must be followed.

4) Efficient soil oriented and crop oriented water management

5) Cost effective environment friendly weed control measures

6) Conservation of natural resources like soil and water is a essential part

7) Environment protection

Lakshminarayana *et al.* (2001) stated that 36 per cent of the sugarcane farmers belonged to low overall adoption level of sustainable sugarcane farming practices and on the other hand, an equal number of farmers i.e., 32 per cent each belonged to medium and high overall adoption levels of sustainable sugarcane farming practices.

Ramanna and Chandrakandhan (2001) reported that the essential components of sustainable agriculture are:

1) Integrated fertility management

It involves restricted use of chemical fertilizers and attempt to meet the nutrient needs of crops with organic materials such as farmyard manure, composts, green manure, sewage, sludge, maximum use of crop residues, use of bio-fertilizers, inclusion of legumes in the crop rotations.

2) Integrated pest management

Pest control by cultural, mechanical, biological and genetic control of insect pests.

3) Integrated disease and weed management by reducing by the dose of chemical

4) Integrated water management

Water is a scarce resource for Indian agriculture and it should be utilized most optimally. All efforts should be made to harness all water resources and their profitable use in the crop production in order to achieve better water use efficiency.

5) Integrated farming system

Farming system integrates all farming enterprises such as crop production, livestock, poultry, forestry, bee keeping etc. in most compatible manner without dislocating the ecological balance.

The studies mentioned above highlighted the concept of sustainable agriculture. It is evident from these studies that sustainable agriculture stresses on better use of internal inputs, restricted use of synthetic pesticides and chemical

fertilizers so that the productivity of the crops can be maintained at lesser cost besides protecting the natural resource base.

Atchuta raju *et al.* (2004) reported that more than half (57.00%) of the respondents belonged to medium level of sustainability, while, 22.00 per cent had low level of sustainability and 21.00 per cent had high level of sustainability.

2.2 COMPONENTS OF SUSTAINABILITY

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

Gale and Cordray (1994) identified nine types of sustainability measured in terms of quantity produced, social system persistence, ecosystem health, price and supply of local products, global ecosystem diversity, ecosystem integrity with external inputs, resistance to ecological crisis, insurance and natural evolution.

Lawrence (1994) proposed the indicators for sustainable agriculture and as a guide to evaluating appropriate technologies are (a) ecological indicators, b) economic indicators and c) social indicators.

Stockle *et al.* (1994) proposed a frame work for evaluating the relative sustainability of a farming system using nine attributes; profitability, productivity, soil quality, air quality, energy efficiency, fish and wild life habitat, quality of life and social acceptance. They recommended scoring based on

quantifiable constraints within each attribute. They also suggested for other evaluation techniques like expert opinion and computer simulation model for those which are not amenable to direct measurement.

Walter and Reisner (1994) used Delphi technique to arrive at dimensions of sustainability and classified these under agrarian / structural and environmental / ecological. Under agrarian / structural aspects three pairs of dimensions viz., centralization – decentralization, dependence – independence, competition – community were included. Under environmental / ecological aspects, domination – harmony with nature, specialization – diversity and exploitation restraint were identified.

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).

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).

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 forstability in yields and productivity (Ramesh and Jayaramaiah, 1996).

Chandregowda (1996) proposed a sustainability index for rice farming which is worked out by quantifying the nine components like nutrient management, water management, integrated pest management, crop yield security, information self-reliancy, input self-reliancy, family food sufficiency land productivity and input productivity.

2.3 PERSONAL CHARACTERISTICS

EDUCATION

Reddy (1991) reported that 8.00 per cent of the farmers were illiterates, 21.00 per cent had received primary education, 35.00 per cent had received high school education while 21.00 and 15.00 per cent received pre-university and graduation, respectively.

Vajpai [1992] found that majority of the beneficiaries belonged to [31.67%] illiterates, followed by [21.67%] high school and 21.67% middle school education. Where as the primary school category was 10.00%, Intermediate category was 8.33% and graduate category was 6.66%. Incase of non-beneficiaries, majority [53.33%] fell under illiterate category followed by 11.67% in primary school category and 5.00% under high school category of education.

Belligeri (1996) revealed that 56.00 per cent of the farmers had received primary education while 14.00, 4.00 and 5.00 per cent of them had undergone high school education, studied upto PUC and graduation, respectively.

Prasad [1996] reported that 49.00% of the selected cashew growers in Guntur and Prakasam districts were illiterates followed by 18.00% with functional literacy, 14.00% with middle school education, 6.00% with college education and 5.00% with high school education.

Rao [1996] stated that functionally literates formed 23.33% followed by 22.50% with formal education upto primary school, 21.67% belonging to illiterates, 17.50% with collegiate education and 7.50% each with middle school and high school education.

Subbarao [1996] observed that 26.00% of the selected Sweet Orange growers in Prakasam district were educated upto primary school followed by middle school [24.00%] Collegiate education [12.00%], High school [10.0%] and 7.00% were functionally literate, while illiterates formed 21.00%.

Veerendranath [2000] revealed that majority of farmers (30.00%) were under illiterate. 18.89% of them belonged to can read only category, 17.22% of them had primary level of education, 16.11% of them belonged to can rad and write category, 9.44% percent were under middle school of education, 6.67% were under intermediate category and the rest 1.67% belonged to graduates and post graduates

Baswarajaiah [2001] reported that nearly 3/4th [74.17%] of the respondents were illiterate followed by 11.67% upto primary school, while 8.33%

of respondents were middle school, where as 4.17% had high school and college level education respectively.

SUGARCANE CULTIVATION EXPERIENCE

Nirmala and Annamalai (1997) stated that 5 respondents (10.00%) had medium farming experience while 10 (20.00%) and 35 (70.00%) respondents had low and high experience respectively.

Rambabu (1997) revealed that 70.00 per cent of the respondents had medium farming experience followed by low (16.00%) and high (13.34%) farming experience in cropping systems.

Reddy (1997) found that majority (65.00%) of the farmers had medium farming experience in sugarcane cultivation.

Satyanarayana (1997) indicated that majority (71.00%) of the respondents fell under the category of medium farming experience followed by 15.00 percent with low farming experience and 14.00 percent with high family experience in oil palm cultivation.

Veerendranath [2000] reported that majority of them [56.11%] had medium farm experience and the rest of them 22.22% and 21.67% had high and low farming experience respectively.

Barwarajaiah (2001) indicated that 29.17 per cent of respondents had low farming experience followed by medium (45.00%) and high (25.83%).

Gattu [2001] has reported the following results on farming experience

Upto 5 years experience :	Nil
6-10 years	0.83%
11-15 years	9.17%
16-20 years	30.83%
above 20 years	59.17%

Sarada (2004) revealed that 37.50 per cent of the farmers had high farming experience followed by low (33.33%) and medium (29.17%) farming experience.

TRAINING RECEIVED

Rao (1988) reported that 46.67 per cent and 40 per cent of farmers were found in medium and high categories of training respectively.

PSYCHOLOGICAL CHARACTERISTICS

ACHIEVEMENT MOTIVATION

Reddy [1990] found that, a large majority of the farmers [70.83%] fell under the medium achievement motivation followed by 17.51% in low and 11.66% in high achievement motivation categories. Bhat [1994], Reddy [1994] and Sivanarayana [1996], in their studies also indicated that majority of the respondents had medium achievement motivation followed below and high achievement motivation respectively.

Prakash [1992] revealed that majority of the A.A.S. had medium achievement motivation followed by high and low achievement motivation.

Rao [1992] noticed that majority of the respondents had average achievement motivation.

Gurappa (1995) reported that little below half (46.67%) of the groundnut farmers belonged to medium level of achievement motivation while 38.89 per cent belonged to high levels of achievement motivation.

Anothram (1996) reported that 56 per cent of paddy cultivation had medium levels of achievement motivation 27.00 per cent had high level and 17.00 per cent had low levels of achievement motivation.

Praveen (1997) reported that majority of mitra kisans belonged to low (44.16%) followed by medium (43.34%) and high (12.50%) levels of achievement motivation.

Paul and Chandra (1998) found that 52.50 per cent of respondents had medium achievement motivation followed by more or less equal per cent of (i.e. 22.5% and 25.00% respondents in low and high achievement motivation categories.

Chandra *et al.* (2000) revealed that 65.00 per cent of the respondents had medium level of achievement motivation followed high (20.83%) and low (14.17%) levels for achievement motivation.

Prakash (2000) revealed that majority (37.50%) of the respondents had medium levels of achievement motivation followed by (32.50%) high and (30.00%) low achievement motivation.

Sridhar (2001) indicated that majority (65.83%) of the respondents had medium achievement motivation followed by high (24.17%) and low (10.00%) achievement motivation.

Hemanthkumar (2002) showed that 61.17 per cent of the oriental tobacco farmers had medium achievement motivation followed by high (20.00%) and low (15.83%) achievement motivation.

Ravichandra Prasad (2002) revealed that 62-50 per cent of the beneficiaires had medium achievement motivation followed by high (25.00%) and low (12.50%) levels of achievement motivation.

Subrahmanyam (2002) revealed that majority (78.34%) of the trained farmers had medium achievement motivation followed by high (18.30%) and low (3.33%) levels of achievement motivation.

Suresh Vittal (2002) observed that three fourths (78.33%) of the respondents had medium achievement motivation, where as 17.50 per cent and 4.17 per cent of their belonged to high and low achievement motivation categories.

Reddy (2003) revealed that majority of rice farmers (66.10%) fell under medium category of achievement motivation followed by high (17.10%) and low (16.70%).

Sarah (2004) concluded that more than half of the respondents (51.57 %) had high achievement motivation, followed by those with low achievement motivation (36.67 %). Around 11.66 per cent had medium achievement motivation.

ATTITUDE TOWARDS SUSTAINABLE FARMING

Kutty (1996) while analyzing the factors responsible for attitude of farmers towards sustainable agriculture found that exposure to interpersonal sources had significant positive relationship, whereas perception about availability of sustainable agricultural techniques and perception about price of agricultural produce had negatively significant relationships with their attitude towards sustainable agriculture.

Gowda (1996) stated that most of the farmers possessed a favourable (67.77%) attitude towards sustainable farming.

Nagabhushanam (1997) reported that majority of the respondents (51.11%) had favourable attitude as their attitude score ranged between 50 to 82 and about 28.33 per cent of respondents had highly favourable attitude, whereas only 20.56 per cent of respondents had negative attitude towards sustainable agriculture. Further, he reported that majority of marginal farmers (60%) and small farmers (54.54%) had favourable attitude whereas 47.73 per cent of big farmers had highly favourable attitude towards

Sriram and Palaniswamy (1999) reported that the farmers had favourable attitude towards eco-friendly agricultural practices in cotton. The reasons were on farm trials, campaign, film shows, video shows, publishing articles in newspapers broadcasting and telecasting articles on EAP in All India Radio and Doordarshan acted as a catalyst in forming favourable attitude towards EAP.

Rahman *et al.* (1999) revealed that most of the farmers possessed a highly favourable attitude towards environment and sustainability issues of agricultural development.

Rahman and Mikuni (1999) stated that half of the farmers in the study area possessed a less than favourable attitude towards sustainability issues of agricultural development. Only 6.00 per cent of them expressed a highly favourable attitude and 44.00 per cent expressed a moderate attitude.

ECONOMIC ORIENTATION

Rambabu [1997] revealed that among wet cropping system farmers majority [48.33%] of them had medium economic orientation followed by low [31.67%] and high [20.00%] economic orientation. In dry cropping systems majority [61.67%] of the respondents had medium economic orientation followed by 21.66% and 16.67% of the respondents who had possessed low and high level of economic orientation respectively. In case of garden cropping systems, 60.00%, 28.33% and 11.67% of the respondents had medium, low and high levels of economic orientation respectively.

Satyanarayana [1997] revealed that 45.00% of the respondents were having medium economic orientation followed by 28.00% and 27.00% with low and high economic orientation respectively.

Rashid [1999] revealed that podu farming participants 25.00%, 25.00% and 50.00% were from high, medium and low categories of economic orientation respectively. In podu dry farming 27.50%, 35.00% and 37.50% were from high medium and low categories of economic orientation respectively. While in Podu

+ dry + wet farming participants 45.00%, 30.00% and 25.00% were from high, medium and low categories of economic orientation respectively.

Veerendranath [2000] stated that majority of them 38.33% and medium economic orientation and the rest of them 32.78& and 28.89% had high and low economic orientation respectively.

LEVEL OF ASPIRATION

Mrutyunjayam (1987) indicated that most majority of farm (72.50%) were having medium aspiration followed by 16.50% had higher aspiration and 11.00 per cent of them were having low aspiration.

Rambabu (1997) revealed that 70.00% of the respondents had medium level of aspiration followed by low (25.00%) and high (50.00%) (5 per cent) levels of aspiration in case of wet cropping systems.

Samuel (2000) revealed that nearly half (48.33%) of the beneficiaries had medium level of aspiration followed by high (39.33%) and low (12.34%) levels of aspiration.

FARMING COMMITMENT

Poor commitment to farming was noticed among irrigated system farmers with a mean level of 29.54 as against 32.74 in rainfed lowland farmers despite possessing higher innovativeness (Chandregowda, 1996).

Reddy (2003) found that majority (56.3%) of the respondents had medium level of farming commitment, followed by low (24.9%) and high (18.8%) farming commitm

SCIENTIFIC ORIENTATION

Samuel (1993) reported that majority of the trained farmers were having medium scientific orientation.

Kumar (1997) reported that majority (45.00%) of the respondents belonged to medium category followed by high 28.30 per cent and low 26.70 per cent categories of scientific orientation. He also reported that majority of the respondents (40.00%) were under medium category of deferred gratification followed by high (36.7%) and low (23.3%) categories.

DECISION MAKING PATTERN

Reddy (1996) revealed that majority of the respondents (60.60%) were medium category of decision making pattern, followed by high (23.30%) and low (16.10%) decision making pattern.

Sreedevi (1996) found that majority of respondents (74.17%) had medium level of decision making pattern, followed by high (20.00%) and low (5.83%) decision making pattern.

Praveen (1997) reported that majority (58.343%) of the respondents had medium level of decision making pattern, followed by low (21.66%) and high (20.00%) decision making pattern.

Devi (2000) concluded that majority (49.28%) of the respondents had medium level of decision making pattern, followed by high (28.26%) and low (22.46%) decision making pattern.

Atchuta Raju (2002) found that majority (65.50%) of the respondents had medium level of decision making pattern, followed by low (20.50%) and high (14.00%) decision making pattern.

SITUATIONAL CHARACTERISTICS

FARM SIZE

Gurrappa (1995) reported that a large majority (86.67%) of the respondents had medium farm size, while 12.22 percent had large farm size and 1.11 percent had small farm size.

Anothram (1996) has conducted a study on constraints faced by paddy cultivating farmer found that 40 per cent of the respondents had medium land holdings followed by small (32.00%), marginal (10.00%) and large (12.00%) land holdings respectively.

Lakshminarayan (1997) revealed that 54.50 per cent of the respondents had small farm size while 45.50 per cent of the respondents had large farm size. He also reported that about 34.00 per cent of the farmers had low farming experience while 32.50 per cent and 33.50 per cent farmers had medium and more experience, respectively.

Praveen [1997] concluded that majority of respondents to small farm size [33.33%] category followed by marginal [25.00%] land less / agricultural labourers [23.33%] and medium [18.34%] categories.

Kumar (1997) observed that 60.00 per cent of the respondents belonged to above 10 acres category while 40.00 per cent belonged to below 10 acres category.

The findings of Rambabu (1997) revealed that 45.00 per cent of the respondents had medium land holding, followed by 30.00 and 25.00 per cent with small land holding and large land holding in wet cropping system respectively.

Kappala [1998] inferred that majority [50.83%] of the respondents were small farmers followed by marginal [30.83%] and big [18.34%] farmers.

Wadea (1998) indicated that majority of the potato growing farmers had small land holding.

Nagdev [1999] revealed that majority of respondents have fallen in semi medium category, 26.00% of respondents had medium land holding while 26.67% possessed small land holding and marginal of 12.00%, only meager number [2.00%] had large land holding.

Nadre (2000) stated that 50.00 percent of respondents had land upto 4.00 hectares, followed by 4.1 to 10.00 hectares category with 32.7 percent. Only 11.50 percent respondents were found in the category of above 10.00 hectares.

Raja Ratnam (2000) reported that almost all the respondents (92.11%) belonged to small farm size category and little number of farmers (7.89%) fall under marginal farm size category.

Gattu [2001] reported that half [50.00%] of the respondents were found to be medium farmers followed by small farmers [35.99%] and large farmers [15.00%]

Loganandhan and Premalatha Singh (2002) observed that majority (43.33%) had 1.1 to 2.0 acres of land and followed by 0.1 to 1.0 acre with 41.67 per cent, landless (8.33%) and 6.67 per cent had above 2 acres of land.

Sarada (2004) found that majority of the farmers were small (40.67%) followed by marginal (30.00%) and big (23.33%) farmer categories.

FAMILY EDUCATIONAL LEVEL

Chandregowda (1996) found that average family education was highest among rainfed lowland rice cultivators (9.55%) followed by upland farmers and least among tankfed rice growers (6.02%).

SUGARCANE CULTIVATION INTENSITY

Chandregowda (1996) reported that irrigated ecosystem and rainfed upland rice ecosystem had significantly higher rice farming intensity (73.67 and 73.64% respectively) whereas it was least in lowland ecosystem with only 43.45 per cent.

SOCIO-ECONOMIC STATUS

Balasubramanian [1985] observed that 53.90% of the pulse growers had high level of extension contact.

Zotwana [1987] reported that majority [66.00%] of trained farmers were having low socio-economic status, where as 26.00% had medium socio-economic status followed by 8.00% with high socio-economic status in studying knowledge, attitude and adoption towards HYV of rice.

Rao [1988] while studying the impact of training programmes conducted by K.V.Ks found that majority [76.00%] of experimental group respondents belonged to medium socio-economic status followed by low and high socio-economic status [12.00% each]

Ananthachary [1990] reported that 70.00% of trained farmers had medium level of socio-economic status followed by 18.34% with high and 11.66% with low levels of socio-economic status.

Sreedevi [1992] observed that majority [53.33%] of trained farm women belonged to medium socio-economic status followed by high [25.00%] and low socio-economic status [21.67%] while studying farm women training conducted by K.V.Ks.

COMMUNICATION VARIABLES

Extension system link

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.

Balasubramanian [1985] observed that 53.90% of the pulse growers had high level of extension contact.

Rao [1988] revealed that large majority [66.00%] of experimental group of farmers were having medium extension contact followed by 22.00% low

extension contact and 12.00% by high extension contact in studying the impact of training programmes conducted by KVKs

Rao (1992) revealed that more than half (56.24%) of the diversified farmers had medium extension contact and the remaining were equally distributed under low and high categories respectively (21.88%).

Belligeri (1996) revealed that 53.00 and 47.00 per cent had regular and occasional contacts with Agriculture Assistant. About 54.00 per cent of the respondents had occasional contact with Assistant Agriculture Officer, followed by regular contact (41.00%) and 5.00 per cent never contacted.

Gowda (1996) stated that most of the farmers possessed a favourable (67.77%) attitude towards sustainable farming.

Ravichandra [1996] stated that more than 4/5th [86.43%] of the trainees maintained medium level of extension contact and remaining 13.57% had high level of extension contact. No one was found with low level of extension contact.

Subbarao [1996] observed that majority [52.00%] of the respondents belongs to medium extension contact category followed by 27.00% with low extension contact and 21.00% with high extension contact.

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).

Reddy (1997) stated that 50.00 per cent of Agriculture + Poultry farmers had medium extension contact followed by high (30.55%) and low (19.45%) extension contact.

Arunadevi [1998] reported that 30.20% of the trainees belonged to low category and other little more than 36.00% of them belonged to medium category, while 24.80% had high category of extension contact.

Reddy (1998) stated that majority of the respondents (82.00%) had medium level of extension contact, followed by 14.67 per cent with high level of extension contact and 3.33 per cent with low level of extension contact.

Ramakrishnan [1999] revealed that 54.17% of the trainees had medium level of extension contact followed by 23.33% with high level and 22.50% with low level of extension contact.

Murthy [2000] identified that majority [64.17%] of beneficiaries of Janmabhoomi programme had medium extension contact.

Ravisankar [2000] revealed that 46.67% of respondents had high level of extension contact followed by medium [30.00%] and low [23.33%] levels in case of Government K.VK, whereas 55.00% had medium level of extension contact followed by low [33.33%] and high [11.67%] levels in NGO-KVK.

Nepaune *et al.* (2001) argued that extension department has not given any attention towards agroforestry in their extension program,

Geetha (2002) inferred that 44.00 per cent of paddy + dairy respondents had medium extension contact followed by high (40.00%) and low (16.00%) extension contact respectively.

Sivanandan (2002) revealed that 42.00 per cent of the respondent had high level of extension contact followed by medium (36.00%) and low (22.00%) levels of extension contact.

Purnima (2004) confirmed the fact that medium extension contact 53.75 per cent followed by high (40.82%) extension contact.

Sarah (2004) found that majority (72.22 %) of the respondents had medium extension contact and 18.89 per cent of the beneficiaries had low extension contact, while 8.89 % had high extension contact.

CONSTRAINTS FACED BY THE FARMERS IN ADOPTING THE SUSTAINABLE CULTIVATION PRACTICES

Rameshbabu (1986) revelaed 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.

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 farmyard manure and lack of technical knowledge were the constraints raced by majority of paddy growing farmers in paddy production (Srivastava and Singh, 1990).

Michael (1990) found that the problems like and degradation, unlogged productive tropical forest and population explosion were linked with a prevailing attitude towards life that was antithesis of human planetary stewardship and of a reverential attitude towards the earth.

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 farmyard 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).

Iqbal and Sumathi (1996) observed that lack of adequate knowledge on the natural predators and parasities, lack of adequate knowledge on the economic threshold level of the different pests, inability to apply pesticides in time,

To observe the eggs and larvas on the leaves, literature having details about the IPM practices, pheromone traps to monitor the pest occurrence facilitating to control the neem seed undertaken by them and make available the neem seed kernels to promote its use against the bollworm as one of the important recommendation in IPM programme.

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

Iqbal and Sumathi (1996) observed that lack of adequate knowledge on the natural predators and parasities, lack of adequate knowledge on the economic threshold level of the different pests, inability to apply pesticides in time, excessive use of synthetic pyrethroids, non-availability of NPV were the major constraints in adopting the integrated pest management practices in cotton.

Reddy (1996) indicated that lack of resources (76.89%), lack of follow up actions by implementing officials (56.00%), lack of technical guidance by scientists (54.67%), lack of efforts on the part of implementing agency to educate and convince the farmers about the importance of people's participation in programme (52.89%), lack of training facilities to all farmers (51.11%), most of the watershed technologies require high level of management (45.78%), lack of adequate contacts with people in pre-project and planning stages (29.33%), officials contact with few farmers only in the village (28.44%), and lack of co-operative effort among the people (26.22%) were the problems expressed by the farmers participating in watershed development programme.

Shinde *et al.* (1997) inferred that cent per cent of cotton growers suggested to provide delinted and certified seed of cotton to prevent initial pest infestation, followed by more than 90.00 per cent of them suggesting to provide a kit comprising magnifying lens.

Rambabu (1997) indicated that the farmers in different cropping systems were facing several constraints in adoption of indigenous technologies. Appearance of periodic drought spells and poor water retention capacity of the soils were the major bio-physical constraints in wet, dry and garden systems respectively. High cost of the neem related products were the major constraint in all the systems. In respect of micro-level constraints, farmers are not willing to take risk was the major constraint in wet and garden cropping systems followed by traditional belief in dry cropping system. With regards to technological constraints, lack of pest and disease resistant varieties was the major constraint in wet and dry cropping systems followed by lack of sufficient bio-gas plants for preparation of slurry as a organic manure in garden cropping system. Whereas, in administrative constraints, lack of more supporting price to the quality products was the major constraint in wet cropping system followed by lack of good grading facilities in dry and garden cropping systems. In case of extension constraints lack of publications on proven indigenous technologies, lack of proper training facilities and lack of organized extension machinery to disseminate the proven indigenous technologies were the major constraints in wet, dry and garden cropping systems respectively.

More *et al.* (1998) revealed that majority (77.86%) of the respondents expressed that the expensiveness of plant protection measures was a major

wet and dry cropping systems followed by lack of sufficient bio-gas plants for preparation of slurry as a organic manure in garden cropping system. Whereas, in administrative constraints, lack of more supporting price to the quality products was the major constraint in wet cropping system followed by lack of good grading facilities in dry and garden cropping systems. In case of extension constraints lack of publications on proven indigenous technologies, lack of proper training facilities and lack of organized extension machinery to disseminate the proven indigenous technologies were the major constraints in wet, dry and garden cropping systems respectively.

More *et al.* (1998) revealed that majority (77.86%) of the respondents expressed that the expensiveness of plant protection measures was a major constraint in adoption of plant protection practices in cotton whereas 65.71 per cent cotton growers expressed that they did not get good price for their product at proper time and 63.57 per cent expressed that high cost of hybrid seed and costly fertilizers and constraints. The difficulties like non-availability of labour at proper time (62.14%). Insufficient supply of water (62.14%), health hazards due to application of insecticides and pesticides (57.14%), more labour requirements for spraying (56.42%) and high cost of improved implements (55.00%) were expressed by the growers.

Nagdeve (1999) revealed that the IPM trained farmers were facing several constraints in adoption of plant protection practices. The most severe constraints pertaining to situational constraints were: fear of low rainfall during the season (72.67%) and non-availability of inputs in time (66.67%). In respect of socio economical constraints, the most important constraints were: lack of

credit facilities (72.00%), high cost of inputs (71.33%) and higher interest on credits (76.00%), with regard to technological constraints, the most important constraints were: lack of simple ETL (68.00%), difficult in implementing biological method due to non-availability of bio-agents (64.00%) and difficulty in maintaining light traps (56:57%), in respect of personal constraints, the most important constraints were: limited finance (77.33%), difficulty in calculating doses of pesticide (68.67%) and difficulty in scouting method (50.67%). With regard to communicational constraints, most important constraints were lack of precise information from change agents (35.33%) and difficulty to contact the extension agency at the time of need (31.33%).

Khan (1999) indicated that the problems faced by the farmers were lengthy procedures of loan building (48.88%), uneven purse (35.56%), less media accessibility (23.33%), research with varying expectations (20.00%), inaccessibility of the source of getting the EFT (13.33%0 and difficulty in getting the farm literature (8.88%).

Nagdeve (1999) revealed that the important suggestions made by the IPM trained farmers to overcome the cosntraints were like timely supply of input at reasonable cost (74.00%), regular farm visit of extension worker (70.00%), arranging more credit facilities (64.00%), less rate of interest on loan (58.00%), providing the subsidy on inputs (42.00%) should be find out. Timely technical guidance (38.00%), organizing more number of training programmes and involved the other farmers of village in training programme (32.00%) and follow up training programmes (28.00%) for successful implementation of IPM programmes and thereby improve the plant protection status of farmers.

Raju and Murthy (2000) inferred that the major constraints encountered by the betelvine growers were: more incidence of pests and diseases, poor economic status of the farmer, lack of varieties for withstanding c7yclonic rains, high cost of fertilizers, lack of good training facilities, poor contacts of extension workers with farmers and low price to farm produce.

Jain and Bhattacharya (2000) indicated that five types of constraints, which includes social, financial, situational, technological and operational. A majority of the respondents (68.00%) reported hat non-awareness about bio-fertilizer product. Other constraints were lack of practical oriented training (64.00%), lack of relevant literature (60.00%), lack of handling skill (56.00%), lethargy due to cumbersome technique (54.00%), lack of confidence on bio-fertilizer input (52.00%) and poor quality of bio-fertilizer (50.00%). Few (44.00%) reported lack of bio-fertilizer supply were center in village and lack of storage facility.

Raju and Murthy (2000) reported that the respondents to overcome the constraints in betelvine cultivation were: exact control measures of diseases and pests, continuous power supply, timely technical guidance, frequent monitoring of technical staff, maintaining demonstration plots, provision of fertilizers on subsidy rates, release of cyclone resistant varieties, conducting training programmes, increase the price of farm produce, supplying effective plant protection chemicals, providing crop insurance, providing bank loans, establishing nearby soil testing labs, and establishment of nearby collection center in that order.

Baswarajaiah (2001) concluded that the problems expressed by the farmers were lack of resources, follow up action by implementing officials, technical guidance by scientists, efforts on the part of implementing agency to educate and convince the farmers about the programme, illiteracy, and the farmers were habituated to subsidies, low level of motivation and less availability of suitable technology for resource poor situations, credit facility, timely supply of inputs.

Baswarajaiah (2001) concluded that the suggestions offered by the farmers for improving participation, making proper follow up action, leadership abilities, encouraged to develop capacity to analyse the problems and interests of people to be provoked to intensity extension activities, timely supply of inputs with subsidized rates, provision of timely technical guidance by scientists provided adequate training for timely execution of soil and moisture conservation works.

2.4 RELATIONSHIP BETWEEN VARIABLES

Neil and Rogers (1963) observed that achievement motivation is significantly related with measures of management of farm.

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 91985).

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.

Sridharan (1981) indicated that scientific orientation had significant Jandhyala and Tilak (1993) observed that education was found. to influence significantly the adoption of various agricultural practices in paddy cultivation

Renukaradhya (1982) 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.

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

Kalliyanpur (1984) reported that farm size and productivity were inversely related. Same results were obtained by Shilaja (1990).

Kalliyanpur (1984) reported that farm size and productivity were inversely related. Same results were obtained by Shilaja (1990).

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

Rao (1985) found a positive and significant correlation between farming performance and farmers' education level, landholding, innovativeness and achievement motivation.

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

Gowda (1988) reported that there was significant relationship between socio-economic status of watershed farmers and their annual farm income but not with farm productivity.

Gowda (1988) reported that there was significant relationship between socioeconomic status of watershed farmers and their annual farm income but not with farm productivity.

Shilaja (1990) found a positive and significant relation of education, extension contact, extension participation, economic motivation, achievement motivation and innovation proneness of farm women with their farm productivity. She also reported that women involvement in farm decision making had no influence.

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

Farmers' age, education and socio-economic status had a positive and significant relationship with 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).relationship with the extent of adoption.

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).

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).

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

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

Lakshminarayana *et al.* (2001) found that achievement motivation and farm scientist contact were having a significant relationship with the adoption level of sugarcane practices at 5 per cent level, whereas education, socio-economic status, attitude, sugarcane farming experience, farming commitment were found to have a significant relationship at 1 per cent level.

Lakshminarayana *et al.* (2001) stated that research system contact was having a significant relationship with the adoption level of sustainable sugarcane farming practices or farmers at 5 per cent level, whereas education, socio economic status, economic motivation, sugarcane farming experience, farming commitment were found to have a significant relationship at one per cent level and farm size was found to have a non significant relationship with the adoption level of sustainable sugarcane farming practices.

2.5 CONCEPTUAL MODEL OF THE STUDY

East West Centre (1977) considered a conceptual framework of schematic model is a diagrammatic representation outlining the dominant elements of a system and their interrelationship with relation to a criterion variable.

Keeping this aspect in view and in the light of inference derived from the evidence in the literature, conceptual framework was developed for the study which represent the important dimension and postulated relationship among variables. The present study was focused on sustainability of sugarcane

cultivation in Visakhapatnam district. Sixteen independent variables representing personal, situational, psychological and communication factors based on expert opinion and review of literature were included to examine the extent of relationship with sustainability of sugarcane cultivation. The relationship was diagrammatically represented in Fig.1, which helped to derive hypothesis for empirical testing.

2.6 DETERMINATION OF HYPOTHESES

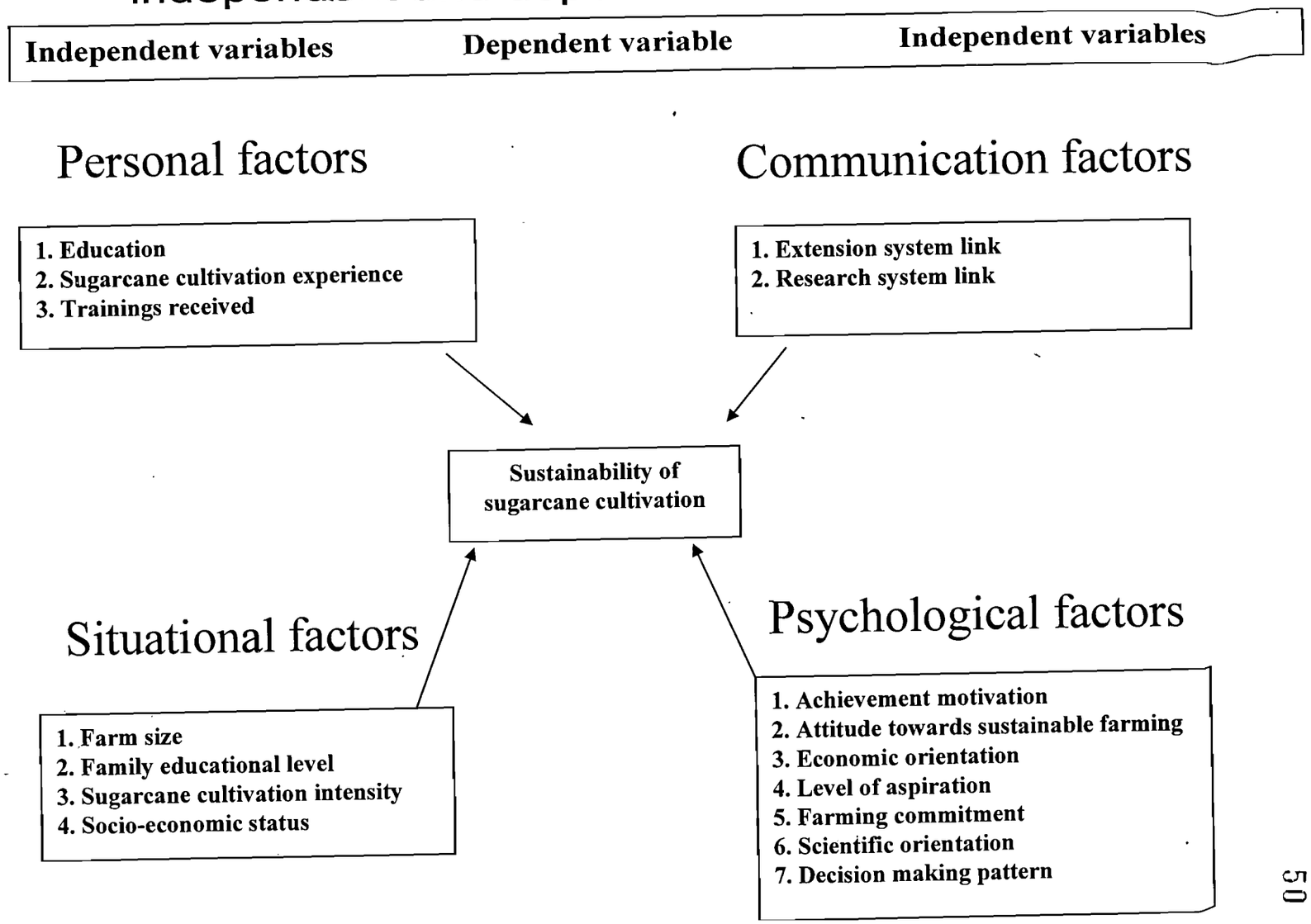
The following general hypotheses was derived and tested in the present study.

General hypothesis

There is an association between the selected personal, situational, psychological and communication factors of the respondents and sustainability of sugarcane cultivation.

The null and empirical hypotheses deduced from general hypotheses with respect to each set of dependent and independent variables under the study were represented in the results chapter.

Fig. 1. Conceptual model showing the relation between independent and dependent variables



Chapter - III

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

The methods and procedures followed in conducting the study are presented in this chapter. The research design, sampling procedure, locale of the study, empirical measurement of the variables, procedures followed in the development of index for measuring the sustainability of sugarcane cultivation, method of collection of data and the statistical tests used in the analysis of data are described in details.

3.1 Research design

3.2 Sampling procedure

3.3 Empirical measurement of variables

3.4 Instruments used for data collection

3.5 Statistical tests used

3.1 RESEARCH DESIGN

An ex- post- facto research design was used for conducting research study, since the variables chosen for the investigation had already occurred. It is a systematic empirical inquiry in which the scientists does not have direct control on independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about relations among variables are made without direct intervention from concomitant variation of independent and dependent variables. (Kerlinger, 1983). Hence, ex-post-facto research design was considered appropriate to analyse sustainability of sugarcane cultivation.

3.2 SAMPLING PROCEDURE

Criteria for selection of the locale of the study, selection of the district, selection of mandals, selection of villages, selection of farmers, selection of researchers and selection of extensionists is explained below.

3.2.1 Locale of the Study

Andhra Pradesh state was chosen for the study purposively since the investigator hails from the same state and is familiar with the local language which would help to build quick rapport with the respondents.

3.2.2 Selection of the District

Viskhapatnam district was selected purposively for conducting research study because of the following reasons.

1. Highest acreage under sugarcane cultivation in the state
2. Sugarcane research station is located in this district
3. No similar type of research work was carried out on the sustainability of sugarcane cultivation in this district.

3.2.3 Selection of Mandals

Six mandals were selected by following simple random sampling method. The selected mandals were :

1. Anakapalle
2. Munagapaka
3. Kasimkota
4. Chodavaram
5. Cheedikada
6. Yellamanchili

3.2.4 Selection of Villages

Out of all irrigated and rainfed villages in each mandal, two irrigated and two rainfed villages were selected by employing the random sampling method. Thus a total of 24 villages were selected for the study.

S. No.	Rainfed villages	S. No.	Irrigated villages
	I. Anakapalle Mandal		**I. Anakapalle Mandal**
1.	Marturu	1.	Venkupalem
2.	Pisinikada	2.	Thummapala
	II. Munagapaka		**II. Munagapaka**
1.	Maduthuru	1.	Thimmarajupeta
2.	Dupputhuru	2.	Andalapalli
	III. Kasimkota		**III. Kasimkota**
1.	Bayyavaram	1.	Kasimkota
2.	Veduruparti	2.	Butcchaiahpeta
	IV. Chodavaram		**IV. Chodavaram**
1.	Chakipalle	1.	Venkannapalem
2.	Narsapuram	2.	Govada
	V. Cheedikada		**V. Cheedikada**
1.	Jaithavaram	1.	Appalarajupuram
2.	Tunivalasa	2.	Cheedikada
	VI. Yellamanchili		**VI. Yellamanchili**
1.	Ramarayudu palem	1.	Etikoppaka
2.	Somalinga palem	2.	Yellamanchili

3.2.5 Selection of Farmers

Ten farmers from each village were selected randomly, thus a total of 240 farmers were selected (120 irrigated + 120 rainfed).

3.2.6 Selection of Researchers

All the scientists of RARS, Anakapalle were selected for the study.

3.2.7 Selection of extensionists

Thirty extensionists from department of Agriculture and sugar factories were selected by employing proportionate stratified random sampling method.

3.3 EMPIRICAL MEASUREMENT OF THE VARIABLES

The related variables for the investigation based on the available literature and opinion of the experts in the field of Agronomy, Soil Science, Agricultural extension, Agricultural Economics, Pathology and Entomology are presented in the Table 1.

Table 1 : Empirical measurement of the variables selected for the study

S. No.	Name of the variable	Empirical measurement
A)	**Independent variables**	
I	**Personal factors**	
1	Education	Scale developed by Trivedi (1963)
2	Sugarcane cultivation experience	Structured questions
3	Training received	Structured questions
II	**Psychological factors**	
1	Achievement motivation	Scale developed by Prasad (1983)
2	Attitude towards sustainable farming	Scale developed by Bues and Dunlop (1991)
3	Economic orientation	Scale developed by Supe (1969)
4	Level of aspiration	Scale developed by Muthayya (1971) with suitable modifications
5	Farming commitment	Scale developed by Gowda (1991) with suitable modifications
6	Scientific orientation	Scale developed by Supe (1969)
7	Decision making pattern	Structured questions
III	**Situational factors**	
1	Farm size	Structured questions
2	Family education level	Structured questions
3	Sugarcane cultivation intensity	Structured questions
4	Socio-economic status	Scale developed by Venkataramaiah (1983) and Revised (1991)

S. No.	Name of the Variable	Empirical Measurement
IV	**Communication factors**	
1	Extension system link	Scale developed by Gowda (1991)
2	Research system link	Schedule developed by Chandre Gowda (1996)
B	**Dependent variable**	
1.	Sustainability of sugarcane cultivation	Index was developed for the study
C	**Indicators for sustainability of sugarcane cultivation**	
a	Soil environment level	
b	Eco-system management	
c	Input use index	
d	Information self reliancy	
e	Input self sufficiency	
f	Integrated nutrient management	
g	Integrated pest management	
h	Land productivity	
i	Input productivity	
j	Crop diversity	
k	Water management	

3.3.1 Independent variables

I. Personal factors

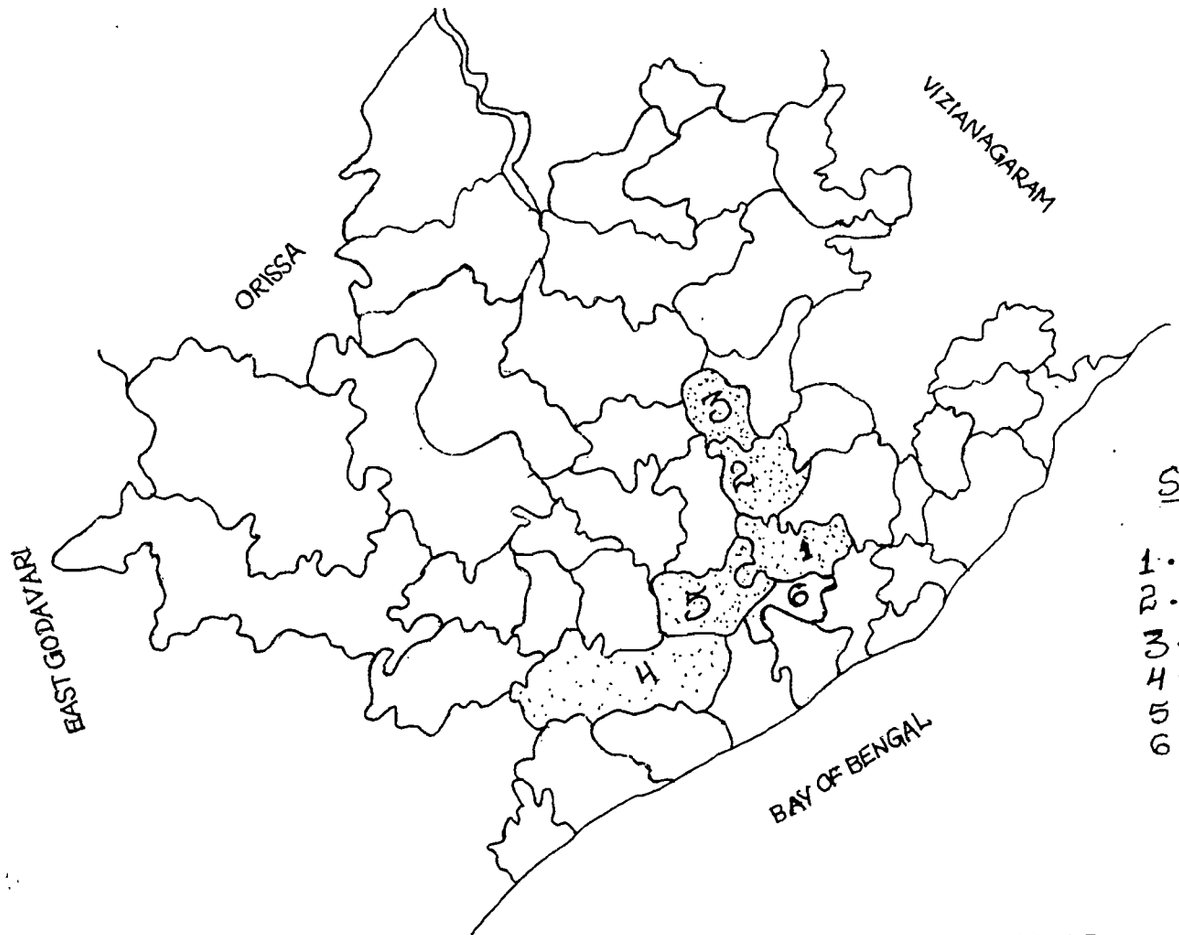
3.3.1.1 Education

Education was operationalized as formal education an individual received.

The following scoring procedure developed by Trivedi (1963) was used .

S. No.	Educational level	Score
1	Illiterate	1
2	Can read only	2
3	Can read and write	3

Fig 2: MAP OF ANDHRA PRADESH SHOWING THE SELECTED DISTRICT



SELECTED MANDALS:

1. ANAKAPALLE
2. CHODAVARAM
3. CHEEDIKADA
4. YELLAMANCHILI
5. KASIMKOTA
6. MUNAGAPAKA

Fig 3: MAP OF VISAKHAPATNAM DISTRICT SHOWING THE SELECTED MANDALS

4	Primary school	4
5	Middle school	5
6	High school	6
7	Intermediate	7
8	Graduates and post graduates	8

Categorization : The grouping was done based on the above categories in order to have clear picture about the formal education.

3.3.1.2 Sugarcane cultivation experience

It was operationlized as the number of years a sugarcane farmer completed in farming. Based on farming experience, farmers were classified into five categories. Scoring followed for farming experience was as follows :

a) Upto 5 years experience 1

b) 5 – 10 years experience 2

c) 10 – 15 years experience 3

d) 15 – 20 years experience 4

e) 20 years and above experience 5

Categorization : Based on mean and standard deviation, respondents were divided into three categories with respect to their experience as follows :

S. No.	Category
1	Low farming experience – Mean – SD and below
2	Medium farming experience – Mean $\pm$ SD
3	High farming experience – Mean + SD and above

3.3.1.3 Training received

Training received was operationally defined as an intensive learning activity for a group of selected sugarcane farmers, assisted by competent trainers to understand and practice the skills required in the adoption of sustainable sugarcane practices, at a place where appropriate facilities exist and at a time and duration considered suitable to the farmers.

A weightage of one was given to each day of training to compute the training score. The scoring was done as given below :

Training days	Score
1 – 5 days	1
5 – 10 days	2
10 – 15 days	3
15 – 20 days	4
More than 20 days	5

Based on the mean and standard deviation the respondents were classified as low, medium and high as follows:

S. No.	Category
1	Low training received– Mean – SD and below
2	Medium training received – Mean $\pm$ SD
3	High training received – Mean + SD and above

II. Psychological factors

3.3.1.4 Achievement motivation

This variable was operationalized as a value associated with a farmer which drives him to excel in farming and thereby attain a sense of personal accomplishment.

Scale developed by Prasad (1983) was used in this study to measure the achievement motivation of farmers. Based on mean and standard deviation, the respondents were classified as low, medium and high achievement motivation.

The scale with a 10 statements and the sub-statements to each of the statement was used. A score of one was given for responses indicating achievement motive and zero for otherwise. Thus, the possible range was upto 30 as follows:

S. No.	Category
1	Low achievement motivation – Mean – SD and below
2	Medium achievement motivation – Mean ± SD
3	High achievement motivation – Mean + SD and above

3.3.1.5 Attitude towards sustainable farming

Attitude is a relative enduring organization of an individual's belief about on object that predisposes his actions.(Rogers and Shoemaker, 1971).The procedure developed by Bues and Dunlop (1991) with suitable modifications was used.

The scoring system consisted of 20 items put in a 5 point continuum as follows:

	Items	**Score**
1.	Strongly agree	5
2.	Agree	4
3.	undecided	3
4.	Disagree	2
5.	Strongly disagree	1

The total score for each farmer was obtained by summing up the scores on each item.

Based on mean and standard deviation, the farmers were classified as low, medium and high as follows :

S. No.	Category
1	Low attitude towards sustainable farming – Mean – SD and below
2	Medium attitude towards sustainable farming – Mean ± SD
3	High attitude towards sustainable farming – Mean + SD and above

Economic orientation

This variable was operationalised as the degree to which a farmer was oriented towards profit maximization in farming and the relative value placed by a farmer on economic ends.

The scale developed by Supe (1969) was used to measure the economic motivation of the respondents. The scoring procedure was done as given below :

Response	Score
Strongly agree	5
Agree	4
Undecided	3
Disagree	2
Strongly disagree	1

S. No.	Category
1	Low economic orientation – Mean – SD and below
2	Medium economic orientation – Mean ± SD
3	High economic orientation – Mean + SD and above

3.3.1.7 Level of aspiration

Aspirations were operationalized as the goal statement that an individual makes about his future level of achievements.

In order to assess the aspirations of sugarcane growers, open ended questions were used covering certain areas of individual needs.

The selection of items for this included open ended questions taken from the aspiration items developed by Muthayya (1971). The areas included to measure the aspirations of farmers were about their expression of aspirational goals in respect of education of his son and daughter, type of work (occupation) to son and daughter, possession of type of house, landholdings, general contentment and possession of livestock.

With the help of items included in the open ended questionnaire the data was obtained. The scoring procedure was done as follows:

a) All of us want to provide education to our children but each one of us may differ with regard to the extent of the education that weight could expect our children to have what would be the level of education you expect?

	Your sons / daughters to have	Score
1	No education	1
2	Primary education	2
3	Middle school	3
4	High school	4
5	College	5
6	Technical / professional	6

b) What would be the type of work you expect?

	Your sons / daughters to have	Score
1	Agriculture	1
2	Government job	2
3	Professional or similar other	3
4	Business	4

c) What would be the type of house you expect to have in next three years?

Type of house	Score
1. No change	1
2. Katcha house (one roomed)	2
3. Katcha house (2 – 3 roomed)	3
4. Mixed house (partly pacca + partly katcha)	4
5. Pacca house (4-5 roomed)	5

d) What would you expect in land holding in next three years?

Increase by

Land holdings	Score
1) No change	1
2) 1 acre	2
3) 2 –3 acres	3
4) 4 – 5 acres	4
5) 6 – 7 acres	5
6) 8 or more acres	6

e) What would you expect to be your general contentment (satisfaction) in life with in next 3 years

Satisfaction level	Score
1. No change	1
2. Some what better	2
3. Certainly better than what it is	3
4. Very high contentment	4

f) What would you expect the position of your livestock (in terms of buffaloes/ cows or bulls) in the next 3 years

Live stock position	Score
1. No change	1
2. One	2
3. 2 – 3	3
4. 4 – 5	4
5. 6 – 7	5
6. 8 and above	6

Categorization

The respondents were classified into three categories based on common mean and ½ S.D.

Low aspiration – Mean – SD and below

Medium aspiration – Mean ± S.D.

High aspiration – Mean + S.D and above

3.3.1.8 Farming commitment

Farming commitment was defined as the degree to which an individual is committed to sugarcane farming as a profession.

Scale developed by Gowda (1991) with suitable modifications was used for the study. Scale consists of 9 statements out of them five items were negative and rest were positive. The response for each statement was stated on a five point continuum ranging from 'strongly agree' to 'strongly disagree'.

The responses were obtained on response categories as given below

Response	SA	A	UD	DA	SDA
Scope for positive statements	5	4	3	2	1
Score for negative statements	1	2	3	4	5

Final score was arrived at by summing up all the corresponding response scores.

Based on mean and standard deviation, the farmers were classified as low, medium and high farming commitment as follows:

S. No.	Category
1	Low farming commitment – Mean – SD and below
2	Medium farming commitment – Mean ± SD
3	High farming commitment – Mean + SD and above

3.3.1.9 Scientific orientation

Scientific orientation was operationally defined as the degree to which a farmer was oriented to the use of scientific methods.

Scale developed by Supe (1969) was used for the study. The scale consists of 6 statements. Out of them, item number two was negative and the rest were positive. The response for each statement was stated on a three point continuum ranging from agree to disagree. The scoring was done as given below

Response	A	UD	DA
Score for positive statements	3	2	1
Score for negative statements	1	2	3

The maximum score an individual could obtain on the scale was 18 and the minimum score could be 6. The final score for scientific orientation may arrived at by summing up all the corresponding response scores.

Based on mean and standard deviation, the farmers were classified as low, medium and high as follows:

S. No.	Category
1	Low scientific orientation – Mean – SD and below
2	Medium scientific orientation – Mean ± SD
3	High scientific orientation – Mean + SD and above

3.3.1.10 Decision making pattern

Decision making pattern was operationalized as the nature of decision making either individually, jointly or collectively that the farm family has resorted to, while performing sugarcane cultivation activities.

Decision making areas were identified and that constituted the schedule. The schedule had 9 decision making areas which were fitted on a 3 point continuum of decision making pattern viz., individual, joint and collective decision with a score of 1, 2, and 3 respectively. Thus, the minimum and maximum possible scores were 9 and 27 respectively. Higher the score more collective decision and lesser the score, more the individual decisions as follows:

S. No.	Category
1	Low decision making pattern – Mean – SD and below
2	Medium decision making pattern – Mean $\pm$ SD
3	High decision making pattern – Mean + SD and above

III) Situational factors

3.3.1.11 Farm size

The farm size referred to the number of standard acres owned by the farmer. The size of land holding of farmer was arrived it by converting the dry and wetland owned into standard acres. Two and half acres of dryland is equal to one acre of wetland as per the section of sub section of (1) b of Andhra Pradesh land reforms (ceiling on agricultural holdings) Act NO. 1 of 1973. A weightage of one was given to each standard acre to get land holding of respondent. Based on the number of acres, they were categorized as follows:

S. No.	Category	
1	Marginal farmers	Upto 2.5 acres
2	Small farmers	2.5 acres and < 5 acres
3	Big farmers	> acres

3.3.1.12 Family educational level

Family education level was taken as the average schooling of the family members. It was measured by diving the total number of schooling years by number of family members who were above five years as followed by Chandra Gowda (1996).

3.3.1.13 Sugarcane cultivation intensity

Sugarcane cultivation intensity was operationalized as the extent of cultivated area being utilized for sugarcane.

Sugarcane cultivation intensity was measured as the ratio of the area under sugarcane to that of gross cultivated area expressed in percentage .

$$\text{Sugarcane cultivation Intensity} = \frac{\text{Area under sugarcane}}{\text{Gross cropped area}} \times 100$$

3.3.1.14 Socio economic status

Scale developed by Venkataramaiah (1983) revised (1991) was used for measuring socio economic status .

Farm size

Type – Dry Irrigated / garden Total :

	House	Weightage
1.	Katcha house	1
2.	Mixed house	2

3.	Pucca house		3
	No. of houses :	One	1
		Two or more	2
	Nature of family :	Single	1
		Joint family	2
	Size of family :	Upto 5 members	1
		Above 5 members	2

Farm power	Weightage
1. Bullocks, bullock carts, wooden ploughs, sickles, spade	One for each item
2. Sprayers, dusters, Iron plough	Two for each item
3.Oil engines, Electric motors	Three for each item

Material Possession

Item	Weightage
1.Cycle, radio, tables, watch and fan	- 1 for each item
2. Sofa, Almyrah, Iron cot	- 2 for each item
3. Motor cycle, T.V.	– 3 for each item

Occupation

1. Cultivation	- 1
2. Cultivation + labour	- 2
3. Cultivation + subsidiary occupation	- 3
4. Cultivation + labour +subsidiary occupation	- 4

Social Participation

1. No membership in any organization	- 0
2. Membership in one organization	- 1
3. Membership in more than one organization	- 2
4. Office bearer	- 3

S.No.	Category
1	Low social-economic status – Mean – SD and below
2	Medium social-economic status – Mean ± SD
3	High social-economic status – Mean + SD and above

IV) Communication factors

3.3.1.15 Extension system link

Extension system link was operationalized as the farmers linkages with extension system through personal contacts and participation in extension activities for acquiring information on farming and development.

The quantification of this variable was done by frequency of contact with extension personnel of development departments and regularity of participation in extension methods such as demonstration, kisan mela and training etc. organized by extension personnel. The scoring was done as given below :

I. Frequency of extension personnel contact	
Frequency of contact	Weightage
Once in a week	4
Once in a fortnight	3
Once in a month	2
Once in two months	1
No contact	0
II participation in extension activities	
Participation	
Regular	2
Occasional	1
Never	0

Final score for extension system link was arrived at by summing up all the corresponding response scores of the above two dimensions.

Based on mean and standard deviation, the respondents were classified as low, medium and high extension system link as follows:

S. No.	Category
1	Low extension system link – Mean – SD and below
2	Medium extension system link – Mean ± SD
3	High extension system link – Mean + SD and above

3.3.1.16 Research system link

Research system link was operationalized as the farmers linkages with research system through correspondence, personal visits or visit of research personnel to their fields and participation in extension activities organized at research stations.

Farmers were asked to give number of times they have established contact with the research systems during the pervious year. Number of contacts or activities were multiplied with respective activity weightage and summed up to arrive at an individual's research system link score.

Schedule developed by Chandre Gowda (1996) was used

S. No.	Activities	Weightage
1	Correspondence with the scientist	1
2	Scientists visits to farmers fields	1
3	Farmers visit to the research station	2
4	Participation in exhibition / workshop / seminar / field day etc. organized at research stations	2
5	Taking up adoption trials and frontline demonstrations	4

The respondents were grouped based on mean and standard deviation as follows:

S. No.	Category
1	Low research system link – Mean – SD and below
2	Medium research system link – Mean ± SD
3	High research system link – Mean + SD and above

3.3.2 Selection of the components for sustainability of sugarcane cultivation

3.3.2.1 Item pool

Sustainability of sugarcane cultivation is the process by which farmer manages soil and water relying mainly on on-farm resources to enhance productivity without affecting the production environment.

With the help of available literature first and then discussions held with the experts, a list of components, purported to be the indicators of sustainable sugarcane cultivation was prepared.

3.3.2.2 Item scrutiny

The components were then scrutinized for their amenability for operationalisation measurement and possibility of eliciting data from farmers. Later on, components were retained as essentials of sustainable sugarcane cultivation.

3.3.2.3 Judges rating

The list thus prepared was subjected to relevancy rating of judges. The judges were of the cadre of Assistant Professors and above in the area of Agricultural extension, agronomy, soil science, entomology, pathology and Agricultural economics. The judges were asked to indicate their response on 3 point relevancy continuum viz., ' most relevant', ' relevant', 'somewhat relevant'.

The operational definition for sustainability of sugarcane cultivation and its components were supplied to judges to orient them towards the broader concept of sustainable agriculture (Appendix)

In all, judges responded to the cell relevancy coefficient of i^{th} component (RCi) was worked by the following formula.

$$Rci = \frac{\text{Total score of all the judges on ith components}}{\text{Maximum score on the continuum x Total number of judges}}$$

Those components with the relevancy coefficient of 0.7 above were selected for the development of index.

Eleven components passed the above criterion were listed below with the relevancy coefficient.

S. No.	Component	Relevancy coefficient
1	Soil environment level	0.78
2	Eco-system management	0.75
3	Input use index	0.75
4	Information self reliancy	0.78
5	Input self sufficiency	0.75
6	Integrated nutrient management	0.85
7	Integrated pest management	0.89
8	Land productivity	0.91
9	Input productivity	0.81
10	Crop diversity	0.72
11	Water management	0.85

3.3.2.4 Computation of scale values

In order to compute the scale value for each of the selected indicators, their relative importance to the sustainable sugarcane cultivation were obtained by experts rating.

Scale values through Guilford's rank order method

The 11 components were presented to 25 selected experts and were asked to rank them in the relative importance by giving 1st rank to most important component and 9th rank to least important components. Using the Guilford (1954)

method, ranks were converted into rank values, centile values were worked out followed by 'C' values and then scale values by using the formula.

$$Rc = 2.357\ Ri - 7.01$$

Scale values of each of the components are given below

S. No.	Component	Scale values
1	Soil environment level	8.07
2	Eco-system management	5.32
3	Input use index	4.78
4	Information self-reliancy	4.78
5	Input self sufficiency	4.78
6	Integrated nutrient management	4.78
7	Integrated pest management	10.04
8	Land productivity	10.43
9	Input productivity	7.05
10	Crop diversiety	4.78
11	Water management	6.58

The scale values have been used to arrive at index of sustainability of sugarcane cultivation for each farmer.

3.3.3 Dependent variable

Measurement of the components of sustainability of sugarcane cultivation

Sustainability of sugarcane cultivation is process by which farmer manages soil and water, relying mainly on on-farm resources to enhance productivity without affecting the production environment.

The scoring procedure followed by Chandre Gowda (1996) was used. However, the detailed measurements were given here:

3.3.3.1 Soil environment level

Soil environment level was operationalized as the extent of adoption of different soil and water conservation practices to protect the fertility level of soil.

Under this indicator four main components were identified by consulting agronomists and soil scientists. They are (1) recycling of farm produce and farm waste 2) soil conservation measures, 3) water conservation measures and 4) vermiculture. For measuring this indicator, 10 statements were prepared, used in collection of information on this and the soil environment level of farmers was calculated. Each of them has the two continuum response, one and two score have been given for non-adoption and adoption, respectively. Minimum possible score was 10 and maximum possible score was 20. The soil environment level of each farmer had been worked out by using the following formula :

$$\text{Soil environment level index} = \frac{\text{Actual score obtained}}{\text{Maximum possible score}} \times 100$$

After obtaining scores, the respondents were categorized into three groups based on mean and S.D. as follows:

S. No.	Category	Score range
1	Low soil environment level	Below (Mean – S.D.)
2	Medium soil environment level	Between (Mean $\pm$ S.D.)
3	High soil environment level	Above ((Mean + S.D.)

3.3.3.2 Eco-system management

Ecosystem management was operationalized as the extent to which the farmers adopt the different biomass production practices to maintain the congenial eco-system.

After consultation with the experts, the components have been identified The biomass production practices identified and their weightage as per the judges opinion are given below :

Components	Weightage
Food crops cover	1
Oilseed and other field crops	2
Fodder crops cover	3
Horticultural crops cover	4
Agro-forestry cover	5

The relevant questions were developed and the data were collected on the aspects. The cumulative score of all the items were worked out and used in calculating the eco-system management index of each farmer. Minimum possible score was 1 and maximum possible score was 15.

$$\text{Eco-system management} = \frac{\text{Cumulative score obtained by farmer}}{\text{Maximum possible score}} \times 100$$

The respondents were categorized into three groups based on mean and S.D.

S. No.	Category	Score range
1	Low eco-system management	Below (Mean – S.D.)
2	Medium eco-system management	Between (Mean ± S.D.)
3	High eco-system management	Above ((Mean + S.D.)

3.3.3.3 Input use index

Input use index was operationalized as the level of adoption of the production inputs for the crops grown by the farmers as against the recommended

level to sustain the crop production. Under this indicator, the components identified are use of organic manure, green manuring, fertilizer application, seed material and bio-fertilizer application after thorough discussion with the experts in the field.

The questions on those aspects were developed and used in the collection of data. For each component, the farmers assigned three score as per 'recommendation', two score for 'deviation from recommendation' and one score for 'non use'.

$$\text{Input use index} = \frac{\text{Cumulative score obtained by the farmers}}{\text{Maximum possible score}} \times 100$$

On the basis of mean and S.D. the respondents were grouped into three categories.

S. No.	Category	Score range
1	Low input use index	Below (Mean – S.D.)
2	Medium input use index	Between (Mean ± S.D.)
3	High input use index	Above ((Mean + S.D.)

3.3.3.4 Information self reliancy

Information self-reliancy was operationalized as the ability of the farmer to possess information required for successful sugarcane farming and to rely upon that at the time of decision making.

Information self-reliancy was measured on a 3 point continuum of reliancy dependency ranging from self, self and others and others with a score of 3, 2 and 1, respectively. Minimum possible score was 20 and maximum possible score was 60.

The information self reliant index was obtained by using the following formula:

$$\text{Information self-reliency} = \frac{\text{Actual score}}{\text{Possible score}} \times 100$$

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows :

S. No.	Category
1	Low information self reliancy – Mean – SD and below
2	Medium information self reliancy – Mean $\pm$ SD
3	High information self reliancy – Mean + SD and above

3.3.3.5 Input self sufficiency

Input self-sufficiency was operationalized as the extent to which farmer was able to meet the input requirement of sugarcane growing from own resources than the purchased inputs. It was taken as the ratio of value of owned inputs to the total value of inputs used in sugarcane farming. The value of inputs was 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:

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

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.

Categorization: Based on mean and standard deviation, respondents were divided into three categories as follows:

S. No.	Category
1	Low input self sufficiency – Mean – SD and below
2	Medium input self sufficiency – Mean ± SD
3	High input self sufficiency – Mean + SD and above

3.3.3.6 Integrated nutrient management

Integrated nutrient management was operationalized as 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.

Keeping the operational definition in mind, a list of questions related to nutrient management was prepared. Maximum care was taken to cover all the aspects of nutrient management in sugarcane. The scoring procedure was done has given below:

Soil testing	**Score**
Last year	1
Last season	2
Present season	3
Not done	0

3.3.3.6.1 Organic manuring

1. Quantity of FYM or compost

As per recommendations	2
Deviation from recommendation	1

2. Time of application

As per recommendations	2
Deviation from recommendation	1

3. Method of application

As per recommendations	2
Deviation from recommendation	1

4. Application of green manure

Green manure crop was raised *in situ*	2
Green leaf manure was brought from outside	1

5. Time of application of green manure

As per recommendations	2
Deviation from recommendation	1

6. Quantity of green manure

As per recommendations	2
Deviation from recommendation	1

3.3.3.6.2 Inorganic manuring

1. Application of nitrogen in split doses	Yes	1
	No	0
2. Application of phosphorus as basal	Yes	1
	No	0
3. Application of Potassium as basal	Yes	1
	No	0

4. Application of fertilizers

a) Nitrogen : As per recommendations	2
Deviation from recommendation	1
b) Phosphorus : As per recommendations	2
Deviation from recommendation	1
c) Potassium : As per recommendations	2
Deviation from recommendation	1

5. Method of application of basal dose

Mixed into the soil at the time of last ploughing	2
Applied on the surface of the soil	1

6. Distribution

Equally applied to all the plots	3
Unequally applied to all the pots	2
Applied to some plots	1

Minimum possible score was 1 and maximum possible score was 45.

Integrated nutrient management index for an individual farmer was worked out by using the following formula:

$$\text{Integrated nutrient management} = \frac{\text{Actual score}}{\text{Possible score}} \times 100$$

Categorization: Based on mean and standard deviation, respondents were divided into three categories as follows:

S. No.	Category
1	Low integrated nutrient management– Mean – SD and below
2	Medium integrated nutrient management – Mean $\pm$ SD
3	High integrated nutrient management – Mean + SD and above

3.3.3.7 Integrated pest management

Integrated pest management was operationalized as the management of pests (insects, diseases and weeds) by using preventive and curative measures through judicious combination of cultural, mechanical, biological and chemical means.

The scoring procedure was done as given below:

3.3.3.7.1 Prophylactic measures

1. Treatments of setts with hot water at 52°C for 30 minutes — Yes 1; No 0
2. Spray of chemicals before appearing the pests and diseases? — Yes 1; No 0

3.3.3.7.2 Curative measures

1. Pest control :
   - As per recommendation — 2
   - Deviation from recommendation — 1
   - No control measure — 0

2. Diseases :	As per recommendation	2
	Deviation from recommendation	1
	No control measure	0
3. a) No. of manual weeding :	As per recommendation	2
	Deviation from recommendation	1
	No control measure	0
b) Weedicide used :	Recommended weedicide	2
	Not recommended weedicide	1
c) Quantity of weedicide	As per recommendation	2
	Deviation from recommendation	1

Minimum possible score was 1 and maximum possible score was 17.

The IPM index was worked out by using the following formula:

$$\text{IPM index} = \frac{\text{Actual score}}{\text{Possible score}} \times 100$$

Categorization: Based on mean and standard deviation, respondents were divided into three categories as follows:

S. No.	Category
1	Low integrated pest management – Mean – SD and below
2	Medium integrated pest management – Mean $\pm$ SD
3	High integrated pest management – Mean + SD and above

3.3.3.8 Land productivity

Land productivity was operationalized as yield per unit area, expressed in terms of tons/ha. Land productivity was taken as the average of the past 3 crops to give weightage to productivity over a period of time.

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

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows :

S. No.	Category
1	Low land productivity – Mean – SD and below
2	Medium land productivity – Mean ± SD
3	High land productivity – Mean + SD and above

3.3.3.9 Input productivity

Input productivity was considered as output per unit of input used. It was expressed as the ratio of gross output to the total variable cost.

$$\text{Input productivity} = \frac{\text{Total value of the output}}{\text{Total variable cost}}$$

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows :

S. No.	Category
1	Low land productivity – Mean – SD and below
2	Medium land productivity – Mean ± SD
3	High land productivity – Mean + SD and above

3.3.3.10 Crop diversity

The narrow focus of the production function on the inputs of land, capital and management and the use of on-farm profitability as the primary definition of sustainability has come under attack from sustainable agriculturalists, who agree that the social and environmental consequences of production are as important as the economic outcomes. Using diversity of crops harvested as an indicator of

sustainability and the production function. Thus, the crop diversity was operationalized as the diversification of crops in the area, genetic diversity within the crop, use of nitrogen fixing crops / trees, raising green manure crops etc. in order to deriving maximum benefits and causing minimum damage to the resource base.

Keeping the operational definition in mind a list of questions related to the components of crop diversity was prepared. Maximum care was taken to cover all the aspects of crop diversity. This list was then subjected to correction by experts. Structured questions were administered and the score of each farmer was arrived. Each component was given the score of three for 'as per recommendation', two for 'deviation from recommendation' and one for 'no diversity'.

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows :

S. No.	Category
1	Low crop diversity – Mean – SD and below
2	Medium crop diversity – Mean $\pm$ SD
3	High crop diversity – Mean + SD and above

3.3.3.11 Water management

Water management was operationalized as the application of practices to obtain added benefits from rainfall and water flow through irrigation for crop production with a proper drainage to keep the soil health intact.

For each component farmers were assigned one score for 'yes' and zero score for 'no'. Minimum possible score was 13 and maximum possible score was 26.

Water management index (WMI) was worked out by using the following formula :

$$WMI = \frac{\text{Actual score}}{\text{Possible score}} \times 100$$

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows :

S. No.	Category
1	Low water management – Mean – SD and below
2	Medium water management – Mean $\pm$ SD
3	High water management – Mean + SD and above

3.3.4 Computation of sustainability index

The eleven indicators have been measured and expressed in different units. Hence, all the values were converted into unit values by using simple range and variability as given below:

$$Uij = \frac{Yij - Min\ Yj}{More\ Yj - Min\ Yj}$$

Where,

Yij = Value of the i^{th} respondent on j^{th} component

Min Yj = Min score on the j^{th} component

Max. Yj = Max. score on the j^{th} component

Uij = Unit value of i^{th} respondent on j^{th} component

These unit values ranged from 0 to 1, when Yij is minimum, unit value is 0 and Yij is maximum, unit value is 1. Then, these unit values of each respondent were multiplied respective component scale values. Summed up, divided by total scale value and multiplied by 100 to get sustainability index for each respondent.

$$\text{Sustainability index} = \frac{\text{Uij Jj}}{\text{Total scale value}} \times 100$$

Where,

Uij = Unit value of the ith respondent on jth component

Sj = Scale value of Jth component

Total scale value = ,

After obtaining score, the respondents were categorized into three groups based on mean and S.D. as follows:

Categorization : Based on mean and standard deviation, respondents were divided into three categories as follows:

S. No.	Category
1	Low sustainability index – Mean – SD and below
2	Medium sustainability index – Mean ± SD
3	High sustainability index – Mean + SD and above

Problems as perceived by farmers regarding sustainability of sugarcane cultivation

To identify the major problems encountered by the farmers in adoption of sustainable sugarcane cultivation, farmers were asked to choose the problem in different areas of sustainable sugarcane cultivation viz., situational, input supply and services, technical and financial.

Suggestions given by the farmers to overcome the problems in adoption of sustainable sugarcane cultivation

An attempt was also made to elicit suggestions from farmers to overcome problem in sustainable sugarcane cultivation. Frequencies and percentages were calculated to interpret the results.

Problems as perceived by scientist and Agricultural Officers regarding sustainable sugarcane cultivation

Problems in sustainability of sugarcane cultivation

Scientists of RARS, Anakapalle and Agricultural Officers were asked to tick the problems in different areas of sustainable sugarcane cultivation viz., situational, input supply and services, technical and financial.

The possible suggestions to overcome the problems pertaining to different areas were also obtained through open / end questions.

3.4 INSTRUMENTS USED FOR DATA COLLECTION

3.4.1 Instruments used for collection of data from farmers

Instrument used for collecting data in the study was pre-tested structured interview schedule. Keeping in view the specific objectives, based on the relevant literature, extension specialists, discussion with researchers and field extension personnel, a schedule was developed. The data were elicited from the farmers through personal interview method.

A schedule thus finalized was used for farmers given in Appendix-I (Part-A).

3.4.2 Instruments used for collection of data from researchers and extensionists

Instrument used for collecting data in the study was pre-tested structure questionnaire. Keeping in view the specific objectives, based on the relevant literature, extension specialists, discussion with researchers and field extension personnel a questionnaire was developed.

A questionnaire thus finalized was used for administering to the scientists and agricultural officers given in Appendix-I (Part-B and C).

3.5 STATISTICAL TESTS USED TO ANALYSE THE DATA

For the purpose of statistical analysis to fulfill the set objective, the following statistical tools were used.

3.5.1 Arithmetic mean (X)

The arithmetic mean is the quotient that results \when the sum of all the items in scores is divided by the number of items (n).

$$X = \frac{\Sigma x}{n}$$

Where,

X = Arithmetic mean

Σx = Sum of scores

n = number of items

3.5.2 Frequency and percentages

Some of the data were subjected to frequencies and percentages and used to know the distribution of respondents according to their variables.

3.5.3 Standard deviation (SD)

Standard deviation is the square root of the mean of the sum of the squares of the deviation taken from the mean of the distribution.

$$\sigma = \frac{1}{n} \Sigma x^2 - \frac{(\Sigma x)^2}{n}$$

Where,

σ = Standard deviation

Σx = Sum of the deviation of the scores from mean

n = Number of items

3.5.4 Pearson coefficient correlation

The relationship between independent and dependent variables findout by computing the coefficient of correlation and also testing the some for its significance.

3.5.5 Multiple linear regression

This statistical tool is used to study the combined or poled effect of independent variables over dependent variables.

3.5.6 Step down regression analysis

The stepwise regression analysis was taken up to finally select the minimum number of variables necessary to account for almost as much of the variance as it is accounted by the total set of independent variables. The increase in R^2 was tested for its significance at each step and stopped at step where the further increase in R^2 was not significant.

'Z' test has been used to find out significant difference between two sample means in respect of dependent variable of respondents i.e., rainfed farmers with irrigated farmers. 'Z' value has been calculated by dividing the difference between the sample means by its standard error.

The computed 'Z' values were compared with the table value at (n-1) d.f. at 1% and 5% level of significance for drawing meaningful conclusions.

All the above statistical procedures were worked out by feeding the processed data in computer.

3.5.7 'Z' score

A score obtained by determining the deviation of a score from the mean and dividing it by the standard deviation of the test.

Chapter - IV

Results

CHAPTER – IV

RESULTS

Based on the specific objectives, the empirical evidence obtained in terms of factual data through objective research procedures designed and developed for the study were analysed by subjecting them to appropriate statistical and analytical tests. The information (data) thus arrived are presented under the following sections.

4.1 Categorisation of the farmers according to personal, situational, psychological and communication factors

4.2 Distribution of farmers according to the level of sustainability of sugarcane cultivation

4.3 Distribution of rainfed farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation

4.4 Distribution of irrigated farmers according to their level of sustainability of sugarcane cultivation practices

4.5 Distribution of farmers according to their level of sustainability in each of the indicators

4.6 Distribution of rainfed farmers according to their level of sustainability in each of the indicators

4.7 Distribution of irrigated farmers according to their level of sustainability in each of the indicators

4.8 Relationship of personal, situational, psychological and communication factors of farmers responsible for sustainability of sugarcane cultivation

4.1 CATEGORIZATION OF FARMERS ACCORDING TO THEIR PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS

4.1.1 Education

Table 2: Distribution of farmers according to their education

Category	Frequency	Percentage
a) Illiterates	22	9.16
b) Can read only	37	15.41
c) Can read and write	30	12.50
d) Primary	40	16.66
e) Middle	52	21.66
f) High School	31	12.90
g) Intermediate	11	4.63
h) Graduates & post-graduates	17	7.08
Total	240	100.00

From the Table 2 it could be revealed that 21.66 per cent had middle school education, while, 16.66 per cent belonged to primary education group, 15.41 per cent can read only group, 12.90 per cent belonged to high school education, 12.50 per cent belonged to can read and write group, while 9.16 per cent belonged to illiterates, whereas 7.08 per cent and 4.63 per cent belonged to graduates & post-graduates and intermediate education, respectively.

4.1.2 Sugarcane cultivation experience

Table 3: Distribution of farmers according to experience

Category	Frequency	Percentage
a) Up to 5 years of experience	26	10.85
b) 5-10 years of experience	34	14.16
c) 10-15 years of experience	56	23.33
d) 15-20 years of experience	58	24.16
e) > 20 years of experience	66	27.50
Total	240	100.00

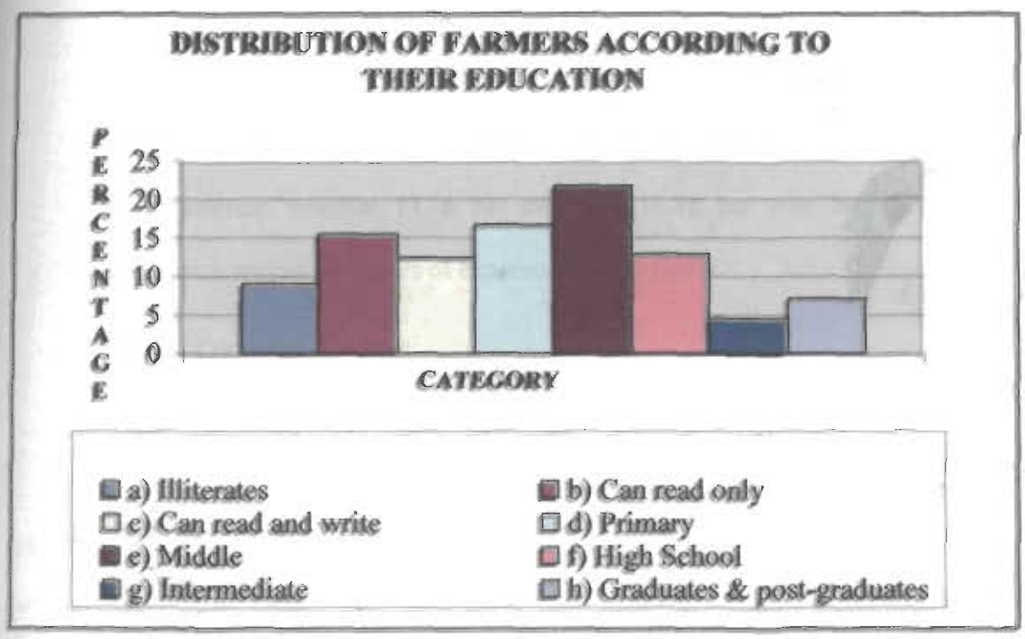


Fig 4: DISTRIBUTION OF FARMERS ACCORDING TO THEIR EDUCATION

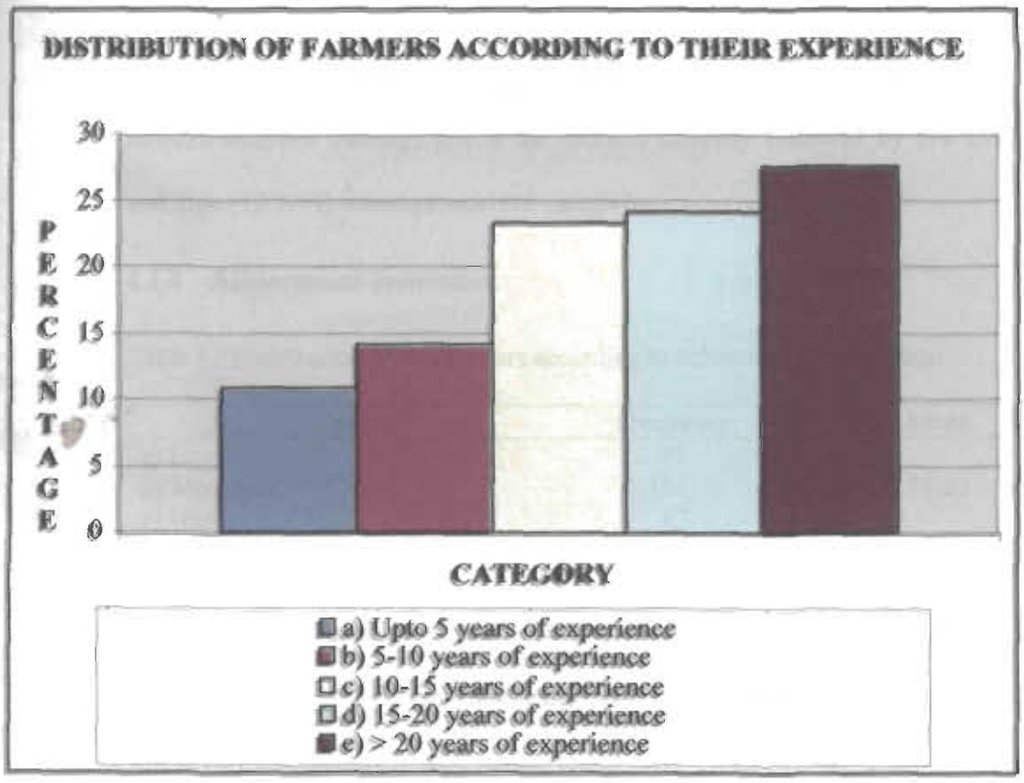


Fig 5: DISTRIBUTION OF FARMERS ACCORDING TO THEIR EXPERIENCE

Results furnished in the Table 3 and Fig.5 reveals that 27.50 per cent of the farmers possessed above 20 years of sugarcane cultivation experience, while 24.16 per cent had 15 to 20 years of experience, 23.33 per cent belonged to 10 to 15 years of experience, whereas 14.16 per cent and 10.85 per cent had 5-10 years of experience and up to 5 years of experience respectively.

4.1.3 Trainings received

Table 4: Distribution of farmers according to trainings received

Category	Frequency	Percentage	Mean	S.D
a) Low	44	18.33		
b) Medium	165	68.75	5.53	2.87
c) High	31	12.92		
Total	240	100.00		

From the Table 4 and Fig.6 it was evident that majority (68.75%) of the farmers received trainings fell in the medium category followed by low (18.33%) and high (12.92%) trainings received categories.

4.1.4 Achievement motivation

Table 5: Distribution of the farmers according to achievement motivation

Category	Frequency	Percentage	Mean	S.D
a) Low	42	17.5		
b) Medium	151	62.9	15.23	6.07
c) High	47	19.60		
Total	240	100.00		

It could be observed from Table 5 and Fig.7 that majority (62.9%) of the farmers were under medium achievement motivation followed by high (19.60%) and low (17.5%) achievement motivation.

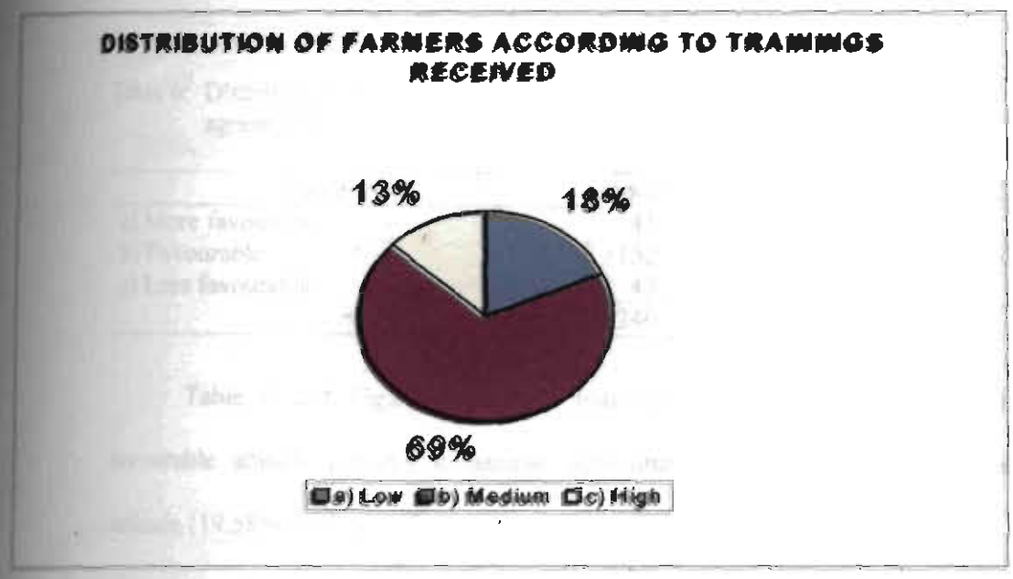


Fig 6: DISTRIBUTION OF FARMERS ACCORDING TO TRAININGS RECEIVED

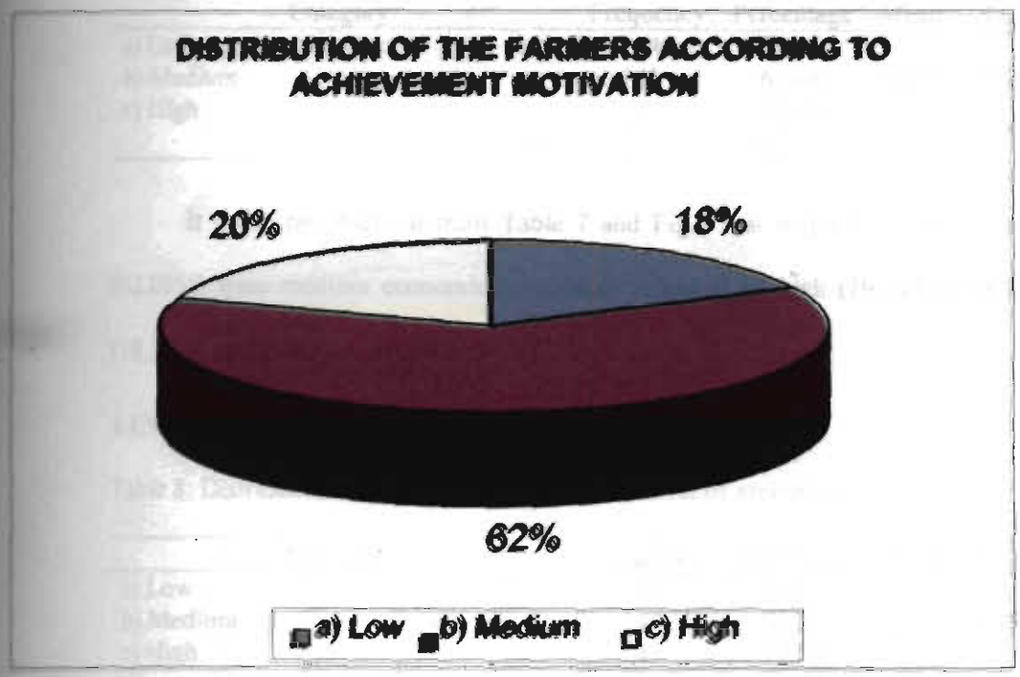


FIG 7: DISTRIBUTION OF THE FARMERS ACCORDING TO ACHIEVEMENT MOTIVATION

4.1.5 Attitude towards sustainable farming

Table 6: Distribution of the farmers according to attitude towards sustainable agriculture

Category	Frequency	Percentage	Mean	S.D
a) More favourable	41	17.09		
b) Favourable	152	63.33	22.33	6.52
c) Less favourable	47	19.58		
Total	240	100.00		

Table 6 and Fig.8 reveals that majority of the farmers (63.33%) had favourable attitude towards sustainable agriculture, followed by less favourable attitude (19.58%) and more favourable attitude (17.09%).

4.1.6 Economic orientation

Table 7: Distribution of the farmers according to economic orientation

Category	Frequency	Percentage	Mean	S.D
a) Low	44	18.34		
b) Medium	149	62.08	18.38	5.56
c) High	47	19.58		
Total	240	100.00		

It could be observed from Table 7 and Fig.9 that majority of the farmers (62.08%) were medium economic orientation followed by high (19.58%) and low (18.34%) economic orientation.

4.1.7 Level of aspiration

Table 8: Distribution of the farmers according to level of aspiration

Category	Frequency	Percentage	Mean	S.D
a) Low	51	21.25		
b) Medium	147	61.25	22.72	7.79
c) High	42	17.50		
Total	240	100.00		

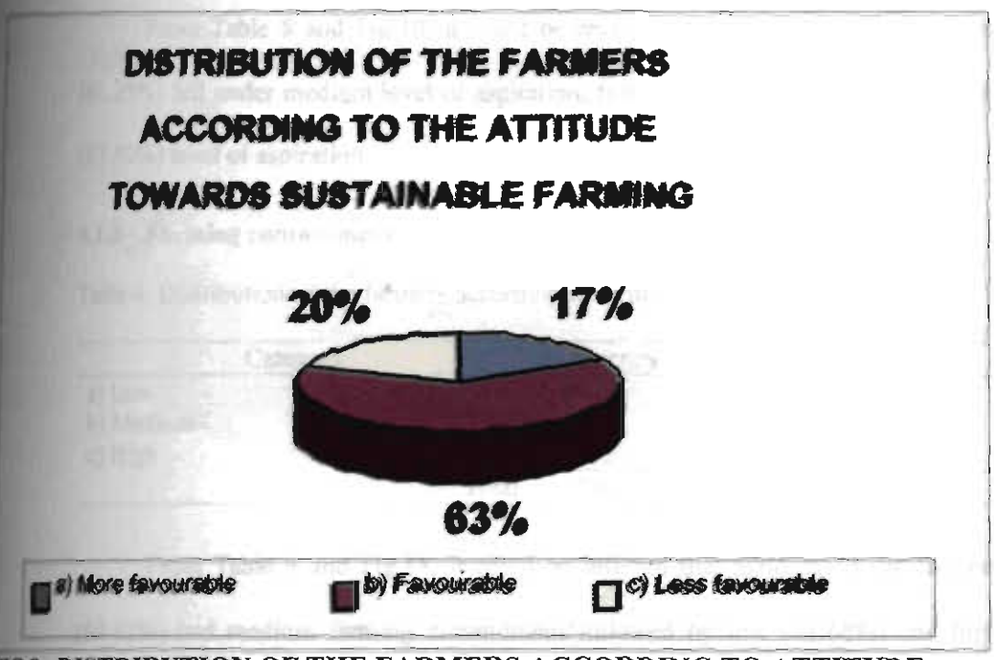


FIG 8: DISTRIBUTION OF THE FARMERS ACCORDING TO ATTITUDE TOWARDS SUSTAINABLE FARMING

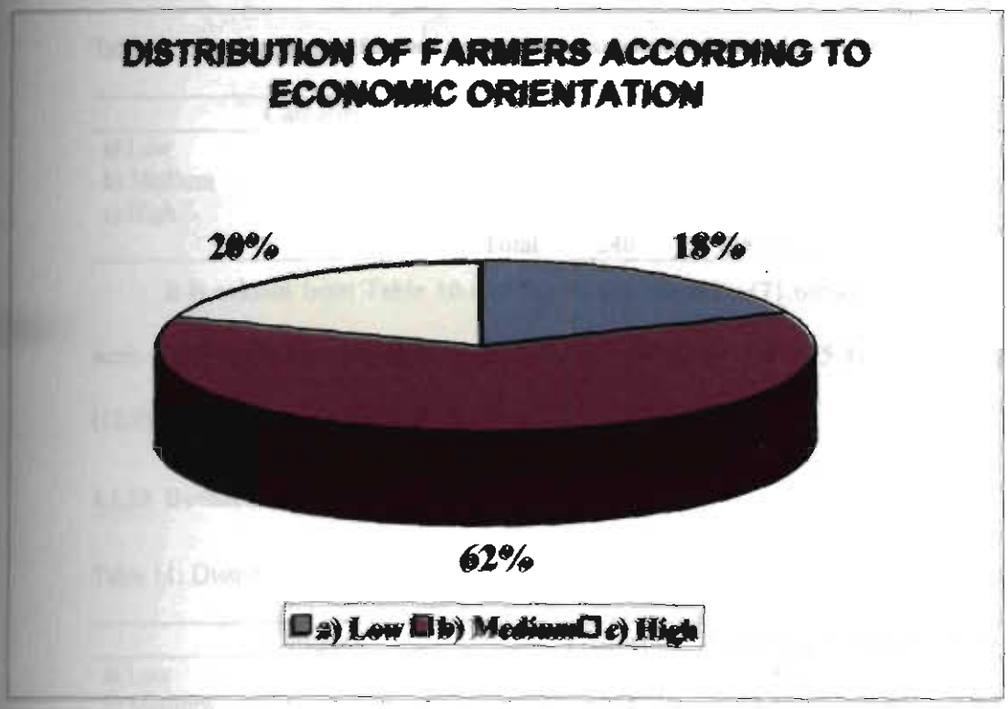


FIG 9: DISTRIBUTION OF THE FARMERS ACCORDING TO ECONOMIC ORIENTATION

From Table 8 and Fig.10, it could be revealed that majority of the farmers (61.25%) fell under medium level of aspiration, followed by low (21.25%) and high (17.50%) level of aspiration.

4.1.8 *Farming commitment*

Table 9: Distribution of the farmers according to farming commitment

Category	Frequency	Percentage	Mean	S.D
a) Low	43	17.91		
b) Medium	145	60.41	19.04	6.44
c) High	52	21.68		
Total	240	100.00		

From Table 9 and Fig.11, it could be inferred that majority of the farmers (60.41%) had medium farming commitment followed by low (21.68%) and high (17.91%) farming commitment.

4.1.9 Scientific orientation

Table 10: Distribution of farmers according to scientific orientation

Category	Frequency	Percentage	Mean	S.D
a) Low	37	15.41		
b) Medium	172	71.66	12.26	2.80
c) High	31	12.93		
Total	240	100.00		

It is evident from Table 10 and Fig.12 that majority (71.66%) of the farmers were under medium scientific orientation, followed by low (15.41%) and high (12.93%) scientific orientation.

4.1.10 Decision making pattern

Table 11: Distribution of farmers according to decision making pattern

Category	Frequency	Percentage	Mean	S.D
a) Low	38	15.84		
b) Medium	154	64.16	9.83	3.84
c) High	48	20.00		
Total	240	100.00		

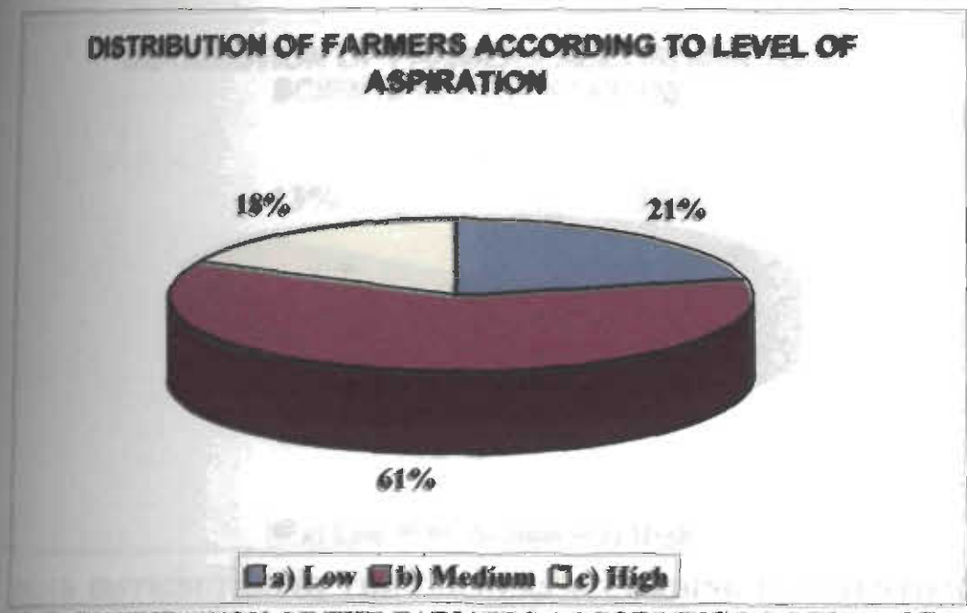


FIG 10: DISTRIBUTION OF THE FARMERS ACCORDING TO LEVEL OF ASPIRATION

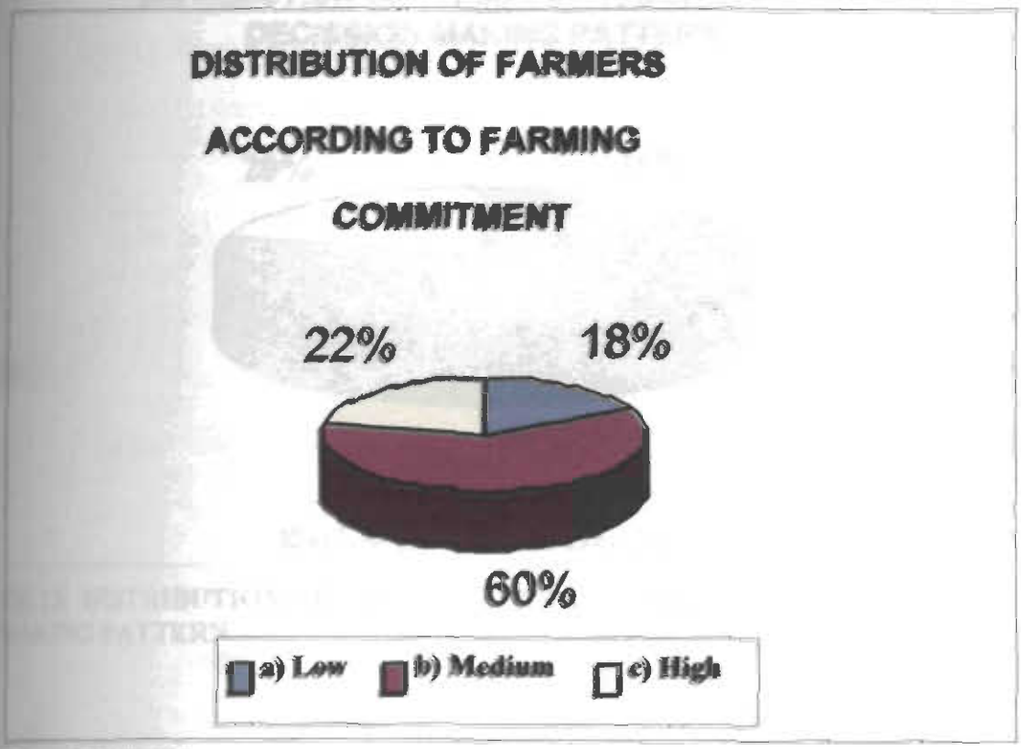


FIG 11: DISTRIBUTION OF THE FARMERS ACCORDING TO FARMING COMMITMENT

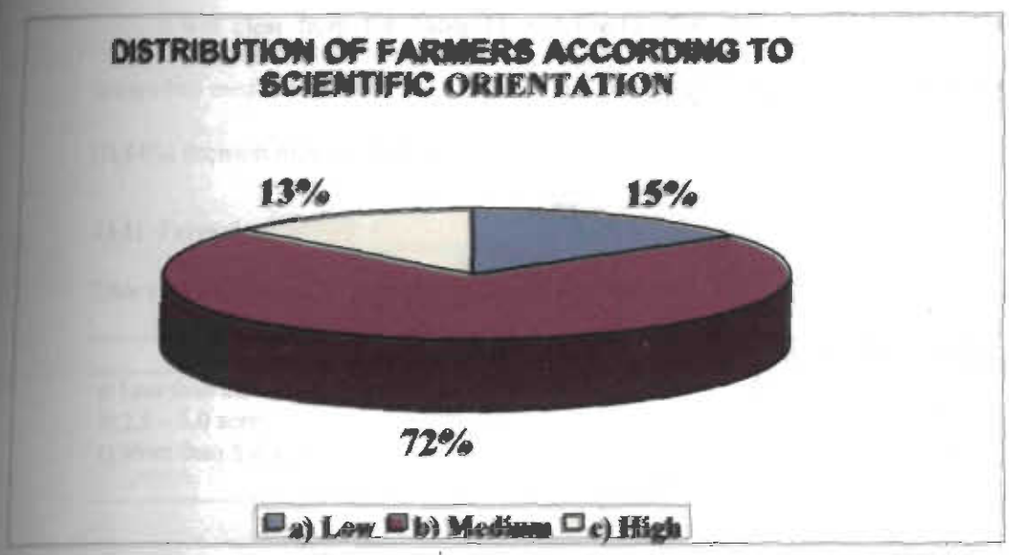


FIG 12: DISTRIBUTION OF THE FARMERS ACCORDING TO SCIENTIFIC ORIENTATION

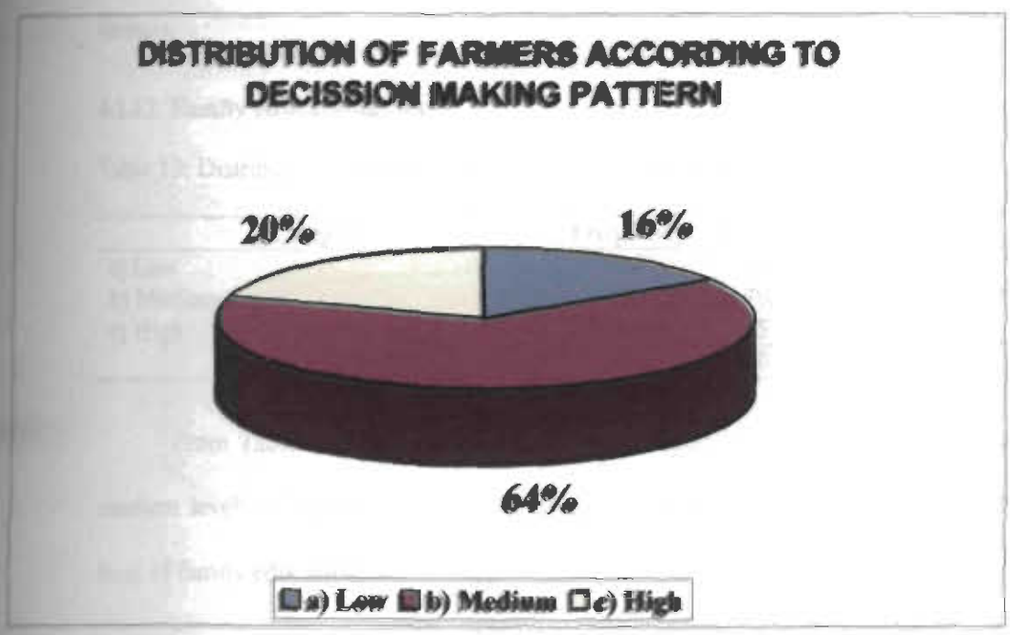


FIG 13: DISTRIBUTION OF THE FARMERS ACCORDING TO DECISSION MAKING PATTERN

It was clear from the Table 11 and Fig.13, that majority (64.16%) of the farmers had medium level of decision making, followed by high (20.00%) and low (15.84%) decision making pattern.

4.1.11 Farm size

Table 12: Distribution of farmers according to farm size

Category		Frequency	Percentage
a) Less than 2.5 acres		42	17.5
b) 2.5 – 5.0 acres		151	62.9
c) More than 5.0 acres		47	19.60
	Total	240	100.00

A perusal of Table 12 and Fig.14 indicated that majority of the farmers (47.92%) were small farmers followed by marginal (37.08%) and big (15.00%) farmers.

4.1.12 Family educational level

Table 13: Distribution of farmers according to family educational level

Category		Frequency	Percentage	Mean	S.D
a) Low		34	14.16		
b) Medium		170	70.84	7.56	0.57
c) High		36	15.00		
	Total	240	100.00		

From Table 13 and Fig.15, it could be revealed that majority (70.84%) had medium level of family education, followed by high (15.00%) and low (14.16%) level of family education.

4.1.13 Sugarcane cultivation intensity

Table 14: Distribution of farmers according to sugarcane cultivation intensity

Category		Frequency	Percentage	Mean	S.D
a) Low		39	16.25		
b) Medium		167	69.58	59.75	12.06
c) High		34	14.17		
	Total	240	100.00		

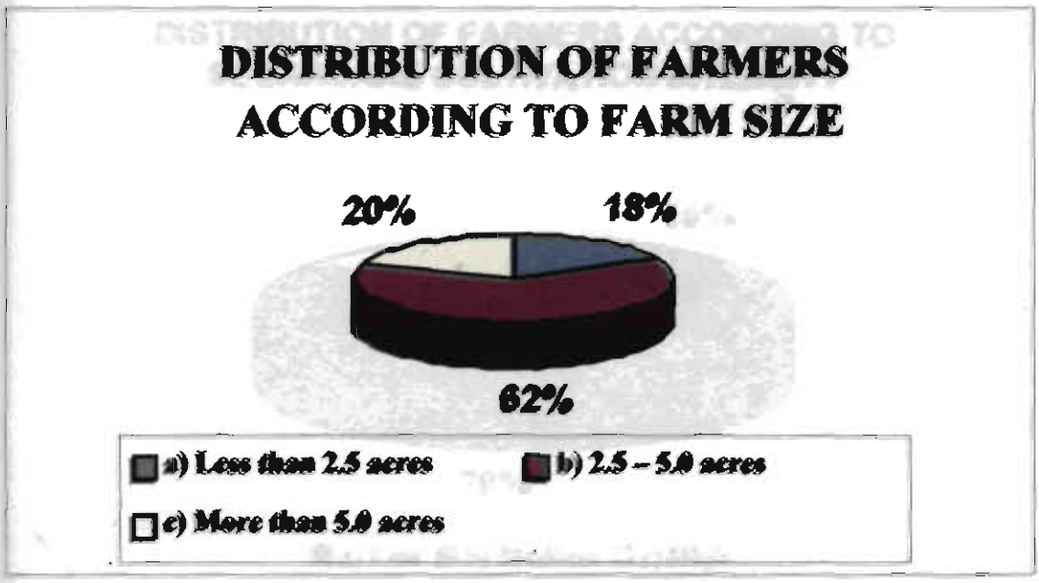


FIG14: DISTRIBUTION OF THE FARMERS ACCORDING TO FARM SIZE

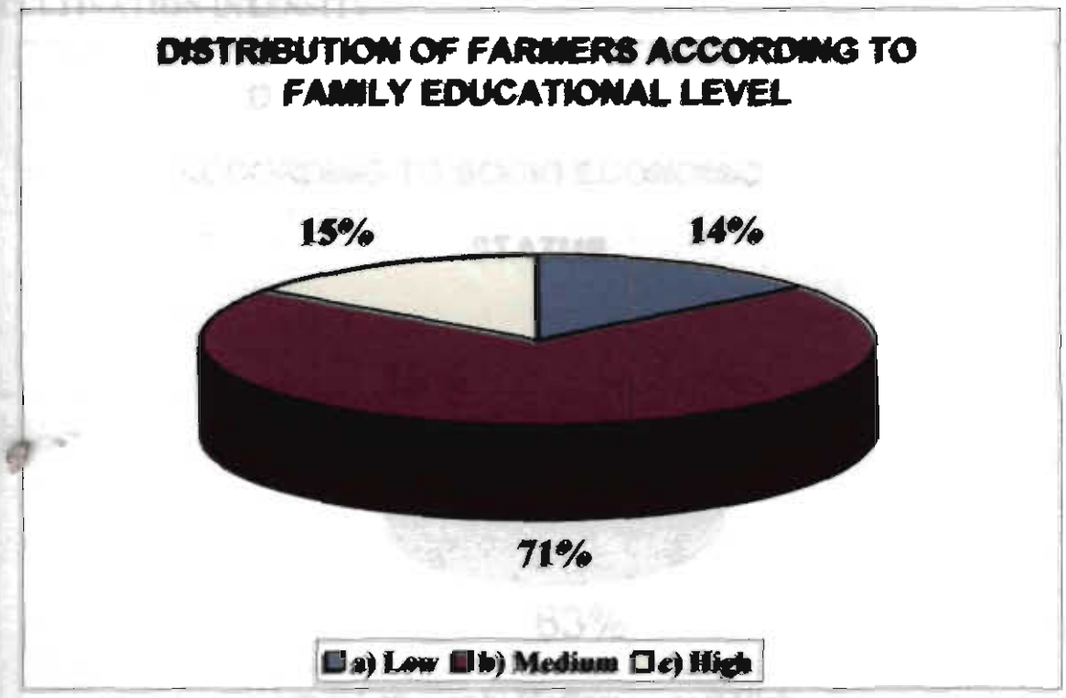


FIG 15: DISTRIBUTION OF FARMERS ACCORDING TO FAMILY EDUCATIONAL LEVEL

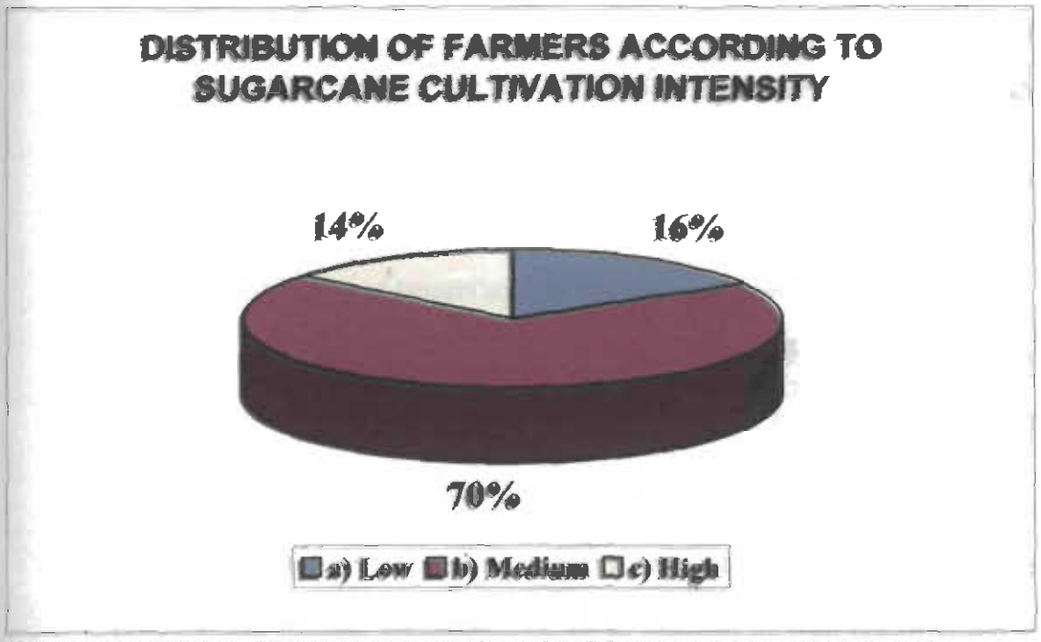


FIG 16: DISTRIBUTION OF FARMERS ACCORDING TO SUGARCANE CULTIVATION INTENSITY

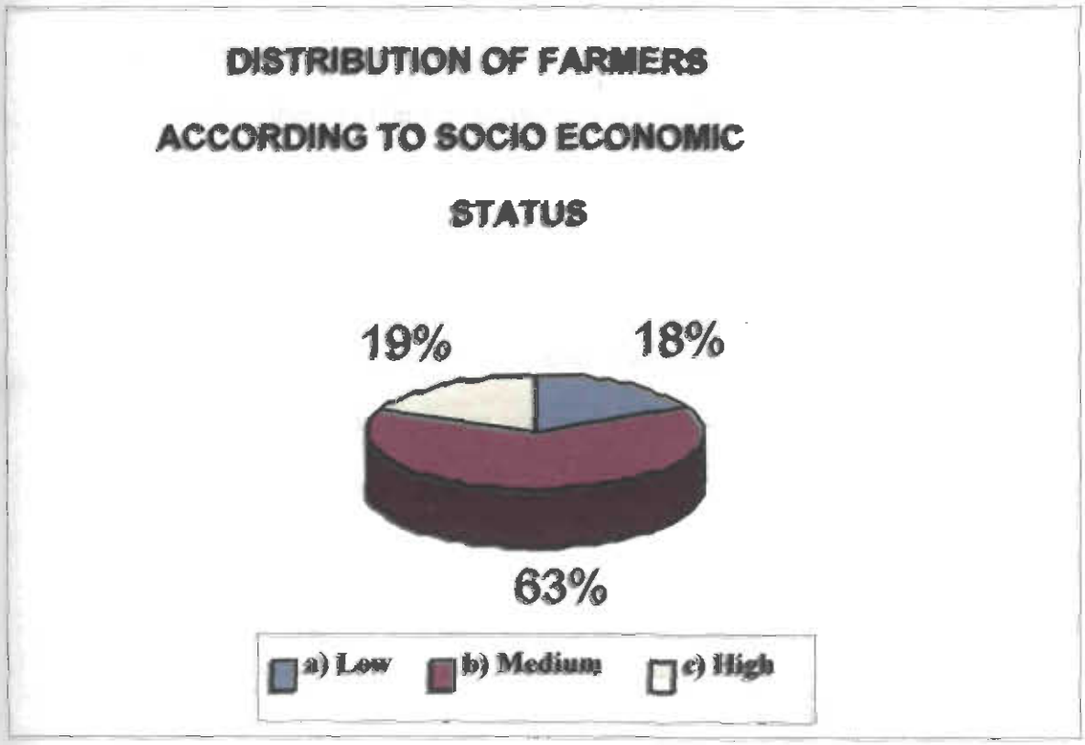


FIG 17: DISTRIBUTION OF FARMERS ACCORDING TO SOCIO-ECONOMIC STATUS

From Table 14 and Fig.16, it could be revealed that majority (69.58%) of the farmers were fell under the category of medium sugarcane cultivation intensity, followed by low (16.25%) and high (14.17%) sugarcane cultivation intensity.

4.1.14 Socio-economic status

Table 15: Distribution of farmers according to socio-economic status

Category	Frequency	Percentage	Mean	S.D
a) Low	43	17.91		
b) Medium	*151*	*62.93*	*14.79*	*5.97*
c) High	46	19.16		
Total	240	100.00		

From Table 15 and Fig.17, it could be inferred that majority of the farmers (62.93%) had medium socio-economic status followed by high (19.16%) and low (17.91%) socio-economic status.

4.1.15 Extension system link

Table 16: Distribution of farmers according to extension system link

Category	Frequency	Percentage	Mean	S.D
a) Low	58	24.16		
b) Medium	122	50.84	15.74	5.97
c) High	60	25.00		
Total	240	100.00		

It could be observed from the Table 16 and Fig.18, that majority (50.84%) of the farmers had medium extension system link, followed by high (25.00%) and low (24.16%) extension system link.

4.1.16 Research system link

Table 17: Distribution of farmers according to their research system link

Category	Frequency	Percentage	Mean	S.D
a) Low	45	18.75		
b) Medium	160	66.66	9.82	4.51
c) High	35	14.59		
Total	240	100.00		

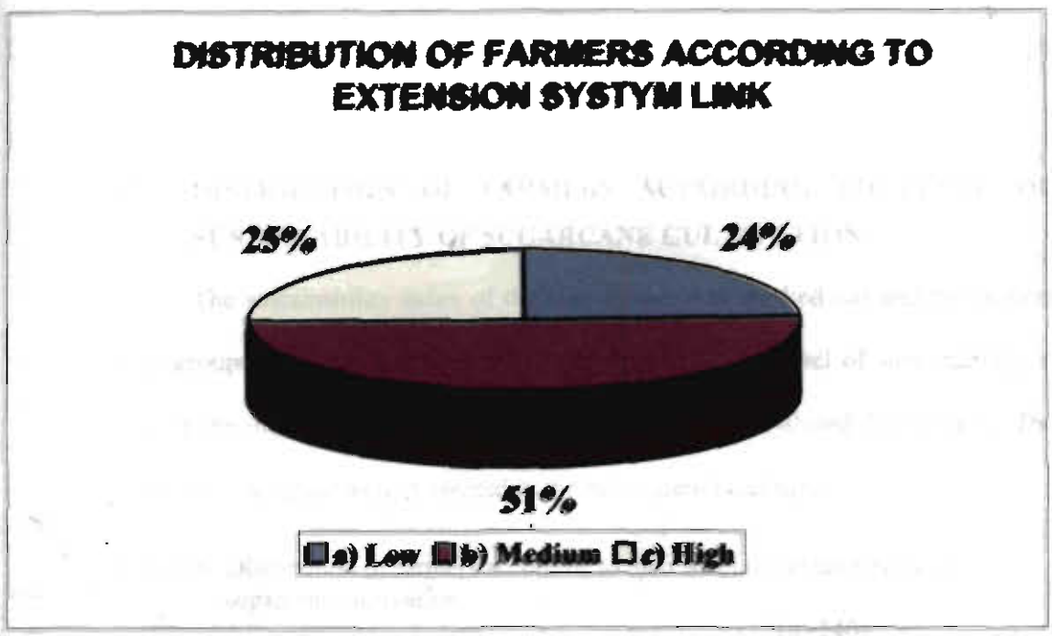


FIG 18: DISTRIBUTION OF FARMERS ACCORDING TO EXTENSION SYSTEM LINK

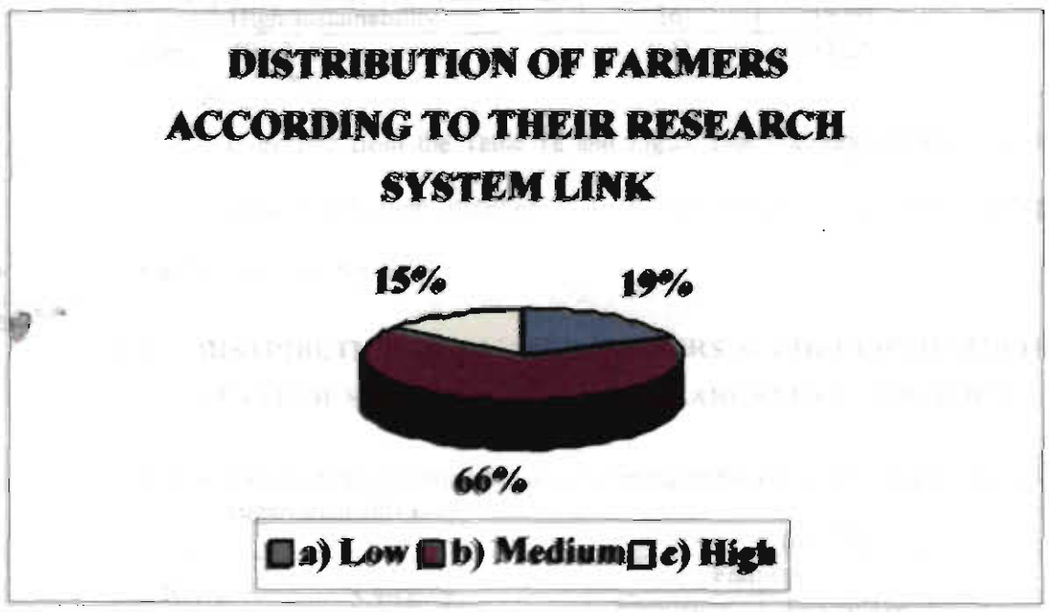


FIG 19: DISTRIBUTION OF FARMERS ACCORDING TO THEIR RESEARCH SYSTEM LINK

It is evident from Table 17 and Fig.19, that majority (66.66%) of the farmers had medium level of research system link, followed by low (18.75%) and high (14.59%) research system link.

4.2 DISTRIBUTION OF FARMERS ACCORDING TO LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

The sustainability index of the each farmer was worked out and the farmers were grouped according to their sustainability level. The level of sustainability in each of the indicators selected in the present study were analysed for farmers. The results in this regard were presented in the subsequent headings.

Table 18: Distribution of farmers according to their level of sustainability of sugarcane cultivation

(n=240)

S. No.	Category	Farmers	
		Frequency	Percentage
1	Low sustainability	46	19.16
2	Medium sustainability	158	65.84
3	High sustainability	36	15.00
Mean	49.67	S.D	11.25

It is evident from the Table 18 and Fig.20 that majority (65.84%) of the farmers were under medium sustainability level, followed by low (19.16%) and high (15.00%) sustainability level.

4.3 DISTRIBUTION OF RAINFED FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

Table 19: Distribution of rainfed farmers according to their level of sustainability of sugarcane cultivation

(n=120)

S. No.	Category	Farmers	
		Frequency	Percentage
1	Low sustainability	26	21.66
2	Medium sustainability	80	66.66
3	High sustainability	14	11.68
Mean	42.43	S.D	8.40

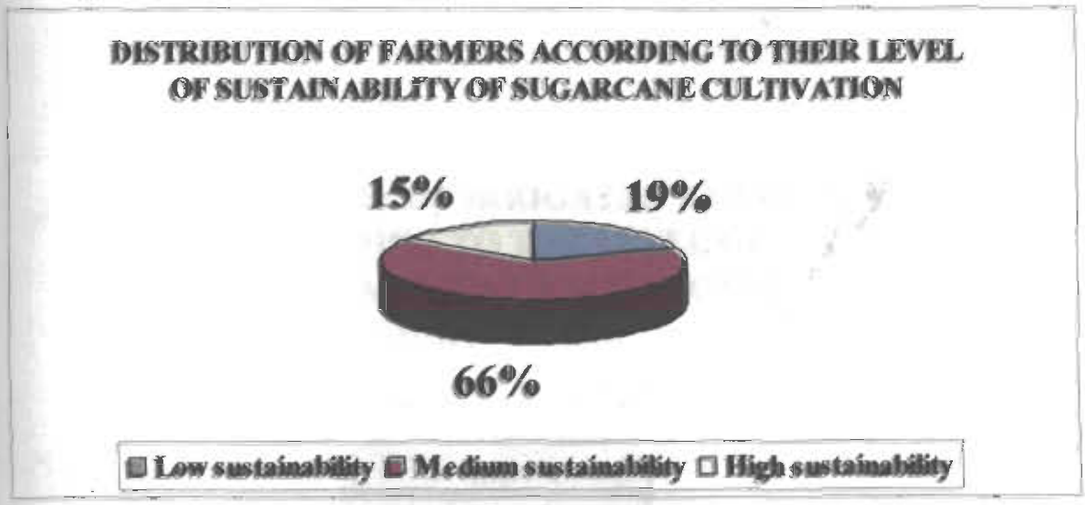


FIG 20:DISTRIBUTION O FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

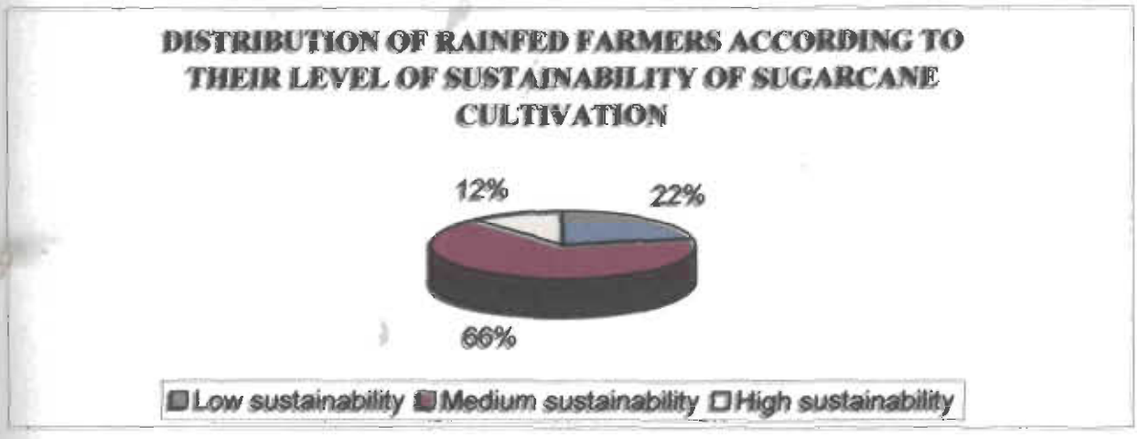


FIG 21:DISTRIBUTION OF RAINFED FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

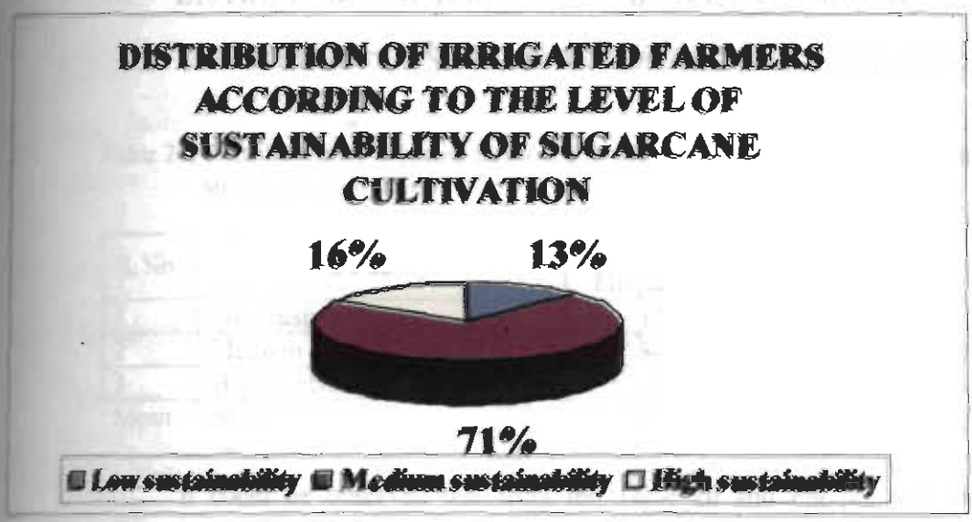


FIG 22:DISTRIBUTION OF IRRIGATED FARMERS ACCORDING TO THE LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

From Table 19 and Fig.21, it could be revealed that majority (66.66%) of the farmers under medium category of sustainability level, followed by low (21.66%) and high (11.68%) level of sustainability.

4.4 DISTRIBUTION OF IRRIGATED FARMERS ACCORDING TO THE LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

Table 20: Distribution of irrigated farmers according to the level of sustainability of sugarcane cultivation

(n=120)

S. No.	Category	Farmers	
		Frequency	Percentage
1	Low sustainability	15	12.50
2	Medium sustainability	86	71.66
3	High sustainability	19	15.84
Mean	56.91	S.D	8.80

It could be observed that from the Table 20 and Fig. 22 that majority (71.66%) of the farmers were under medium category of sustainability level, followed by high (15.84%) and low (12.50%) sustainability level.

4.5 DISTRIBUTION OF FARMERS ACCOORDING TO LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS

It is vivid from the Table 21 and Fig.23 that majority (77.92%) of the farmers were maintained the medium soil environment level, followed by low (12.08%) and high (10.00%) soil environment level.

Ecosystem management was done at the medium level by 66.25 per cent, and at low and high level by 18.75 per cent and 15.00 per cent respectively. The input use index of farmers expressed that 53.33 per cent of farmers used the inputs to the medium level followed by 24.58 per cent used high level of inputs and only 22.09 per cent used low level of inputs for the crops grown by the farmers.

Table 21: Distribution of farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation

S.No	Indicators	Category			Mean	S.D
		Low	Medium	High		
1	Soil environment level	29 (12.08)	187 (77.92)	24 (10.00)	79.64	11.59
2	Eco system management	45 (18.75)	159 (66.25)	36 (15.00)	52.41	21.55
3	Input use index	53 (22.08)	128 (53.33)	59 (24.58)	70.27	14.72
4	Information self reliance	45 (18.75)	136 (56.67)	59 (24.58)	31.62	6.62
5	Input self sufficiency	13 (5.42)	177 (73.75)	50 (20.83)	33.27	13.32
6	Integrated nutrient management	52 (21.67)	146 (60.83)	42 (17.50)	67.91	14.93
7	Integrated pest management	63 (22.25)	137 (57.08)	40 (16.67)	54.96	20.42
8	Land productivity	58 (24.17)	139 (57.92)	43 (17.92)	0.82	0.09
9	Input productivity	31 (12.92)	174 (72.50)	35 (14.58)	1.40	0.21
10	Crop diversity	33 (13.75)	176 (73.33)	31 (12.92)	61.29	18.82
11	Water management	55 (22.92)	135 (56.25)	50 (20.83)	70.68	12.52

Figures in parentheses indicate percentages.

Majority of the farmers (56.67%) had medium level of information self-reliance followed by high and low to the extent of 24.58 per cent and 18.75 per cent respectively.

Majority (73.75%) of the farmers had medium input self sufficiency followed by high (20.83%) and low (5.42%) input self sufficiency.

Majority (60.83%) of the farmers had medium level of integrated nutrient management, followed by low (21.67%) and high (17.50%) level of integrated nutrient management. The medium level of integrated pest management was observed by the extent of 57.08 per cent followed by low (22.25%) and high (20.67%) level of integrated pest management practices to control the pests and diseases.

Majority (57.91%) of the farmers had medium level of land productivity per unit area, followed by low (24.17%) and high (17.92%) land productivity. Majority (72.50%) of the farmers had medium level of input productivity, followed by high (14.58%) and low (12.92%) level of input productivity.

Majority of the farmers (73.33%) had medium level of crop diversity, followed by low (13.75%) and high (12.92%) crop diversity. The medium level of water management was observed by the extent of 56.25%, followed by low (22.92%) and high (20.83%) level of water management.

4.6 DISTRIBUTION OF RAINFED FARMERS ACCORDING TO LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS

An observation of findings in the Table 22 and Fig.24 revealed that majority (73.33%) of the farmers were maintained the medium soil environment level, followed by low (15.00%) and high (11.67%) soil environment level. Ecosystem

Table 22: Distribution of rainfed farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation

S.No	Indicators	Category			Mean	S.D
		Low	Medium	High		
1	Soil environment level	18 (15.00)	88 (73.33)	14 (11.67)	79.08	12.26
2	Eco system management	37 (30.83)	54 (45.00)	29 (24.17)	43.72	20.77
3	Input use index	21 (17.50)	78 (65.00)	21 (17.50)	64.72	14.42
4	Information self reliance	21 (17.50)	78 (65.00)	21 (17.50)	29.12	6.48
5	Input self sufficiency	7 (5.83)	85 (70.83)	28 (23.33)	34.00	14.01
6	Integrated nutrient management	24 (20.00)	68 (56.67)	28 (23.33)	62.12	13.58
7	Integrated pest management	18 (15.00)	80 (66.67)	22 (18.33)	48.88	19.26
8	Land productivity	23 (19.17)	82 (68.33)	15 (12.50)	0.79	0.08
9	Input productivity	22 (18.33)	80 (66.67)	18 (15.00)	1.34	0.20
10	Crop diversity	22 (18.33)	66 (55.00)	32 (26.67)	57.87	18.15
11	Water management	27 (22.50)	75 (62.55)	18 (15.00)	63.94	9.32

Figures in parentheses indicate percentages.

management was maintained by 45.00 per cent of the farmers at medium level, whereas 30.83 per cent and 24.17 per cent of the farmers maintained the ecosystem management at low and high level respectively. The input use index of farmers expressed that 65.00 per cent of farmers used the inputs to the medium level, followed by equal number of farmers (17.50%) expressed high and low level of inputs used for the crops grown by the farmers.

Majority (65.00%) of the farmers had medium level of information self-reliance followed by equal number of farmers had high and low (17.50%) information self-reliance. Majority (65.00%) of the farmers had medium input self sufficiency, followed by equal number of farmers had high and low (17.50%) input self sufficiency.

Majority (56.67%) of the farmers had medium level of integrated nutrient management, followed by high (23.33%) and low (20.00%) level of integrated nutrient management. The medium level of integrated pest management was observed by the extent of 66.67 per cent followed by high (18.33%) and low (15.00%) level of integrated pest management practices to control the pests and diseases.

Majority (68.33%) of the farmers had medium level of land productivity per unit area, followed by low (19.17%) and high (12.50%) land productivity. Majority (66.67%) of the farmers had medium level of input productivity, followed by low (18.33%) and high (15.00%) input productivity.

Majority (55.00%) of the farmers had medium level of crop diversity, followed by high (26.67%) and low (18.33%) level of crop diversity. Majority

(62.55 %) of the farmers had medium level of water management followed by low (22.50%) and high (15.00%).

4.7 DISTRIBUTION OF IRRIGATED FARMERS ACCORDING TO LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS

An observation of findings in the Table 23 and Fig.25 revealed that majority of the farmers (8250%) maintained the medium soil environment level, followed by low (9.17%) and high (8.33%) soil environment level. Ecosystem management was done at the medium level by 54.17 per cent, whereas 25.00 per cent and 20.83 per cent of the farmers done to the extent of high and low level respectively. The input use index of farmers expressed that 55.00 per cent of farmers used the inputs to the medium level, followed by low (23.33%) and high (21.67%) level of inputs used for the crops grown by the farmers.

Majority of the farmers (61.67%) had medium level of information self-reliance followed by high (21.66%) and low (16.67%) information self-reliance. Majority (76.67%) of the farmers had medium input self-sufficiency, followed by high (18.33%) and low (5.00%) input self-sufficiency. Majority (61.67%) of the farmers had medium level of integrated nutrient management, followed by high (20.00%) and low (18.33%) level of integrated nutrient management. The medium level of integrated pest management was observed by the extent of 59.17 per cent followed by high (25.00%) and low (15.83%) level of integrated pest management practices to control the pests and diseases.

Majority (61.67%) of the farmers had medium level of land productivity per unit area, followed by high (24.17%) and low (14.16%) level of land productivity. Majority (65.00%) of the farmers had medium level of input productivity, followed

Table 23: Distribution of irrigated farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation

S.No	Indicators	Category			Mean	S.D
		Low	Medium	High		
1	Soil environment level	11 (9.17)	99 (82.50)	10 (8.33)	80.20	10.91
2	Eco system management	25 (20.83)	65 (54.17)	30 (25.00)	61.11	18.68
3	Input use index	28 (23.33)	66 (55.00)	26 (21.67)	75.83	12.85
4	Information self reliance	20 (16.67)	74 (61.67)	26 (21.67)	34.12	5.78
5	Input self sufficiency	6 (5.00)	92 (76.67)	22 (18.33)	32.55	12.62
6	Integrated nutrient management	22 (18.33)	74 (61.67)	24 (20.00)	73.70	14.00
7	Integrated pest management	19 (15.83)	71 (59.17)	30 (25.00)	61.04	19.80
8	Land productivity	17 (14.17)	74 (61.67)	29 (24.17)	0.84	0.09
9	Input productivity	17 (14.17)	78 (65.00)	25 (20.83)	1.46	0.20
10	Crop diversity	32 (26.67)	67 (55.83)	21 (17.50)	64.72	18.92
11	Water management	19 (15.83)	85 (70.83)	16 (13.33)	77.43	11.68

Figures in parentheses indicate percentages.

by high (20.83%) and low (14.17%) level of input productivity. Majority (55.83%) of the farmers had medium level of crop diversity, followed by low (26.67%) and high (17.50%) level of crop diversity. Majority (70.83%) of the farmers had medium level of water management, followed by low (15.83%) and high (13.34%) level of water management.

4.7.1 DIFFERENCE IN SUSTAINABILITY SCORES OF RAINFED AND IRRIGATED FARMERS

Table 24: Difference in sustainability scores of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	42.43	8.40	112.19**
2	Irrigated	56.92	8.80	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between the sustainability of rainfed and irrigated farmers, the mean sustainability scores were subjected to 'Z' test and the results are presented in Table 24.

Null hypothesis: There will be no significant difference between the mean sustainability scores of rainfed and irrigated farmers.

Empirical hypothesis: There is a significant difference between the mean sustainability scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of sustainability. Further, when the means are compared between rainfed and irrigated farmers it is evident that the mean sustainability scores of irrigated farmers (56.92) more higher to that of rainfed

farmers (42.43) indicating that the irrigated farmers had higher level of sustainability than rainfed farmers.

4.7.2 Difference in scores of soil environment level of rainfed and irrigated farmers

Table 25: Difference in scores of soil environment level of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	79.08	12.26	8.71**
2	Irrigated	80.21	10.91	

'Z' – Critical value significant at 0.01probability level.

In order to find out the significant difference if any between the soil environment level of rainfed and irrigated farmers, the mean soil environment level scores were subject to 'Z' test and the results were presented in Table 25.

Null hypothesis: There will be no significant difference between the mean soil environment level scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be a significant difference between the mean soil environment level scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of soil environment level.

4.7.3 Difference in scores of ecosystem management of rainfed and irrigated farmers

Table 26: Difference in scores of ecosystem management of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	43.71	20.77	134.69**
2	Irrigated	61.11	18.68	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between the ecosystem management of rainfed and irrigated farmers, the mean ecosystem management scores were subject to 'Z' test and the results were presented in Table 26.

Null hypothesis: There will be no significant difference between the ecosystem management scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean ecosystem management scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of ecosystem management.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of ecosystem management. Further, when the means are compared between rainfed and irrigated farmers, it is evident that the mean ecosystem management scores of irrigated farmers (61.11) were higher to that

of rainfed farmers (43.72) indicating that the irrigated farmers had higher level of sustainability than the rainfed farmers.

4.7.4 Difference in scores of input use index of rainfed and irrigated farmers

Table 27: Difference in scores of input use index of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	64.72	14.42	86.07**
2	Irrigated	75.83	12.85	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between the input use index of rainfed and irrigated farmers, the mean input use index scores were subject to 'Z' test and the results were presented in Table 27.

Null hypothesis: There will be no significant difference between the mean input use index scores of rainfed and irrigated farmers.

Empirical hypothesis: There is a significant difference between the mean input use index scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of input use index. Further, when the means were compared between rainfed and irrigated farmers, it is evident that the mean input use index scores of irrigated farmers (75.83) were higher to that of rainfed farmers (64.72) indicating that irrigated farmers had higher level of input use index than rainfed farmers.

4.7.5 Difference in scores of information self reliancy of rainfed and irrigated farmers

Table 28: Difference in scores of information self reliancy of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	29.13	6.48	38.73**
2	Irrigated	34.13	5.78	

'Z' – Critical value significant at 0.01probability level.

In order to find out the significant difference if any between the information self reliancy of rainfed and irrigated farmers, the mean information self reliancy scores were subject to 'Z' test and the results were presented in Table 28.

Null hypothesis: There will be no significant difference between the mean information self reliancy scores of rainfed and irrigated farmers.

Empirical hypothesis: There is a significant difference between the mean information self reliancy scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of information self reliency.

4.7.6 Difference in scores of input self sufficiency of rainfed and irrigated farmers

Table 29: Difference in scores of input self sufficiency of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	34.00	14.01	32.55**
2	Irrigated	11.23	12.66	

'Z' – Critical value significant at 0.01probability level.

In order to find out the significant difference if any between the input self sufficiency of rainfed and irrigated farmers, the mean input self sufficiency scores were subjected to 'Z' test and the results were presented in Table 29.

Null hypothesis: There will be no significant difference between the mean input self sufficiency scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of input self sufficiency.

4.7.7 Difference in scores of integrated nutrient management of rainfed and irrigated farmers

Table 30: Difference in scores of integrated nutrient management of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	62.13	13.58	89.70**
2	Irrigated	73.71	14.20	

'Z' – Critical value significant at 0.01probability level.

In order to find out the significant difference if any between the integrated nutrient management of rainfed and irrigated farmers, the mean integrated nutrient management scores were subject to 'Z' test and the results were presented in Table 30.

Null hypothesis: There will be no significant difference between the mean integrated nutrient management scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean integrated nutrient management scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of integrated nutrient management. Further, when the means were compared between rainfed and irrigated farmers, it is evident that the mean integrated nutrient management scores of irrigated farmers (73.71) were higher to that of rainfed farmers (62.13), indicating that irrigated farmers had higher level of integrated nutrient management than rainfed farmers.

4.7.8 Difference in scores of integrated pest management of rainfed and irrigated farmers

Table 31: Difference in scores of integrated pest management of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	49.03	19.26	93.06**
2	Irrigated	61.04	19.80	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between the integrated pest management of rainfed and irrigated farmers, the mean integrated pest management scores were subject to 'Z' test and the results were presented in Table 31.

Null hypothesis: There will be no significant difference between the mean integrated pest management scores of rainfed and irrigated farmers.

Empirical hypothesis: There is a significant difference between the mean integrated pest management scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of integrated pest management.

4.7.9 Difference in scores of land productivity of rainfed and irrigated farmers

Table 32: Difference in scores of land productivity of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	79.89	0.08	37.01**
2	Irrigated	84.67	0.09	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between the land productivity of rainfed and irrigated farmers, the mean integrated pest management scores were subjected to 'Z' test and the results were presented in Table 32.

Null hypothesis: There will be no significant difference between the mean land productivity scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean land productivity scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of land productivity.

4.7.10 Difference in scores of input productivity of rainfed and irrigated farmers

Table 33: Difference in scores of input productivity of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	1.35	0.20	0.88**
2	Irrigated	1.46	0.20	

'Z' – Critical value significant at 0.01 level of probability.

In order to find out the significant difference if any between input productivity of rainfed and irrigated farmers, the mean input productivity scores were subject to 'Z' test and the results were presented in Table 33.

Null hypothesis: There will be no significant difference between the mean input productivity scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean input productivity scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of input productivity. The calculated 'Z' value was compared with the table value.

4.7.11 Difference in scores of crop diversity of rainfed and irrigated farmers

Table 34: Difference in scores of crop diversity of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	57.87	18.15	53.07**
2	Irrigated	64.72	18.92	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between crop diversity of rainfed and irrigated farmers, the mean crop diversity scores were subject to 'Z' test and the results were presented in Table 34.

Null hypothesis: There will be no significant difference between the mean crop diversity scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean crop diversity scores of rainfed and irrigated farmers.

The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of crop diversity.

4.7.12 Difference in scores of water management of rainfed and irrigated farmers

Table 35: Difference in scores of water management of rainfed and irrigated farmers

S. No.	Category	Mean	S.D.	'Z' value
1	Rainfed	62.60	9.32	112.96**
2	Irrigated	77.18	11.66	

'Z' – Critical value significant at 0.01 probability level.

In order to find out the significant difference if any between water management of rainfed and irrigated farmers, the mean crop diversity scores were subject to 'Z' test and the results were presented in Table 35.

Null hypothesis: There will be no significant difference between the mean water management scores of rainfed and irrigated farmers.

Empirical hypothesis: There will be significant difference between the mean water management scores of rainfed and irrigated farmers.

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The calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of water management.

4.8 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Correlation coefficients indicating the strength of relationship between independent and dependent variables are given in Table 36. The coefficients of correlation (r) have been tested for significance by calculating 't' value and comparing the 't' values with table values.

The personal factors namely education, sugarcane cultivation experience and trainings received had positive and significant relationship with sustainability of sugarcane cultivation. The psychological variables comprising achievement motivation, attitude towards sustainable agriculture, economic orientation, level of aspiration and farming commitment had positive and significant relationship with sustainability of sugarcane cultivation.

The situational variables socio economic status exhibited positive and significant relationship with sustainability of sugarcane cultivation. Both the communication variables viz., extension system link and research system link had positive and significant relationship with sustainability of sugarcane cultivation.

Table 36: Correlation co-efficient of selected independent variables of farmers with the sustainability of sugarcane cultivation

Variables	Correlation co-efficient
Education	0.797**
Sugarcane cultivation experience	0.532**
Trainings received	0.630**
Achievement motivation	0.259**
Attitude towards sustainable farming	0.317**
Economic orientation	0.217**
Level of aspiration	0.275**
Farming commitment	0.288**
Scientific orientation	0.100
Decision making pattern	0.094
Farm size	0.118
Family education level	0.102
Sugarcane cultivation intensity	0.172
Socio economic status	0.637**
Extension system link	0.577**
Research system link	0.328**

* Significant at 0.05 level of probability (r > 0.1285)
** Significant at 0.01 level of probability (r > 0.1684)

4.9 CONTRIBUTION OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF FARMERS WITH SUSTAINABILITY OF SUGARCANE CULTIVATION

To know the contribution of personal, situational, psychological and communication factors of farmers with sustainability of sugarcane cultivation, multiple linear regression analysis was carried out for all the sixteen independent variables against sustainability of sugarcane cultivation.

Table 37 indicated that the variables namely trainings received, attitude towards sustainable agriculture, economic orientation, farming commitment, decision making pattern, family education level, socio-economic status, extension system link and research system link were found positively significant with sustainability of sugarcane cultivation.

The value of coefficient of multiple determination (R^2) was found to be 0.62, indicating that all the independent variables put together could explained variation in the dependent variable of sustainability of sugarcane cultivation to the extent of 62.00 per cent. The 'f' test of statistics indicated that the variation was significant both at 5 per cent and 1 per cent level of significance.

4.10 PREDICTION OF INDEPENDENT VARIABLES CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Null hypothesis

The few variables which contributed towards maximum variation cannot be delineated from the rest of the variables which have negligible cultivation towards the sustainability of sugarcane cultivation.

Table 37: Regression co-efficient of selected independent variables of farmers with the sustainability of sugarcane cultivation

Variables	b	Std. Error	t
Education	0.370	0.348	1.063
Sugarcane cultivation experience	0.346	0.537	0.644
Trainings received	0.496*	0.247	2.010
Achievement motivation	0.002	0.116	0.020
Attitude towards sustainable farming	0.269*	0.107	2.511
Economic orientation	0.477**	0.128	3.726
Level of aspiration	0.028	0.092	0.300
Farming commitment	0.312**	0.112	2.788
Scientific orientation	0.086	0.266	0.322
Decision making pattern	0.386*	0.185	2.082
Farm size	0.281	0.473	0.593
Family education level	5.177**	1.226	4.223
Sugarcane cultivation intensity	0.137	0.059	0.801
Socio economic status	0.323**	0.119	2.720
Extension system link	0.212*	0.101	2.105
Research system link	0.403*	0.158	2.544

R^2 – 0.6215 'F'-value: 22.782

* Significant at 0.05 level of probability (r > 1.960)

** Significant at 0.01 level of probability (r > 2.575)

Empirical hypothesis

The scores on few variables which contributed maximum for variation could be delineated from the rest of the variables which have negligible contribution for variation in sustainability of sugarcane cultivation.

Table 38 shows the results of step down regression analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in sustainability of sugarcane cultivation.

It could be observed from the Table 38 that, there were five variables viz., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 61 per cent variation in sustainability of sugarcane cultivation. The F calculated value was found to be significant ($P < 0.05$). The contribution of above five variables contributed significantly positive.

4.11 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF RAINFED FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Correlation coefficients indicating the strength of relationship between independent variables and dependent variable are given in Table 39. The coefficient of correlation (r) have been tested for significance by calculating 't' value and comparing the 't' values with table values.

Among the personal factors, training received had positive and significant relationship with sustainability of sugarcane cultivation. Among the psychological variables, attitude towards sustainable agriculture, farming commitment and

Table 38: Step down regression analysis of personal, situational, psychological and communication factors of farmers on sustainability of sugarcane cultivation

Variables	'b' value	SE	't' value
Trainings undergone (X3)	0.495	0.1990	2.4874
Attitude towards sustainable agriculture (X5)	0.6170	0.2543	2.426
Farming commitment (X8)	0.5268	0.1985	2.653
Extension system link (X15)	0.2486	0.1093	2.274
Research system link (X16)	0.521	0.2623	1.9861
	$R^2 = 0.6157$	F value = 8.46	

Table 39: Correlation co-efficient of selected independent variables of rainfed farmers with the sustainability of sugarcane cultivation

Variables	Correlation co-efficient
Education	0.000
Sugarcane cultivation experience	0.107
Trainings received	0.239**
Achievement motivation	0.079
Attitude towards sustainable farming	0.348**
Economic orientation	0.007
Level of aspiration	0.046
Farming commitment	0.286**
Scientific orientation	0.096
Decision making pattern	0.257**
Farm size	0.109
Family education level	0.108
Sugarcane cultivation intensity	0.061
Socio economic status	0.102
Extension system link	0.180**
Research system link	0.489**

* Significant at 0.05 level of probability (r > 0.1285)
** Significant at 0.01 level of probability (r > 0.1684)

decision making pattern were positive and significant relationship with sustainability of sugarcane cultivation.

Among the situational variables, no variable was found significant with adoption of sustainable sugarcane cultivation. Both the communication variables viz., extension system link and research system link were found positive and significant relationship with sustainability of sugarcane cultivation.

4.12 CONTRIBUTION OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF RAINFED FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Multiple linear regression analysis was carried out for all the sixteen independent variables against sustainability of sugarcane cultivation.

Table 40 indicated that the variables namely training received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link were found positively significant with sustainability of sugarcane cultivation.

The value of coefficient of multiple determination (R^2) was found to be 0.63, indicating that all the independent variables put together could explain variation in the dependent variable sustainability of sugarcane cultivation to the extent of 63.00 per cent. The 'f' test of statistics indicated that the variation was significant at 5 per cent level of significance.

Table 40: Regression co-efficient of selected independent variables of rainfed farmers with the sustainability of sugarcane cultivation

Variables	b	Std. Error	t
Education	0.123	0.509	0.242
Sugarcane cultivation experience	1.497	0.636	2.353
Trainings received	1.031**	0.306	3.369
Achievement motivation	-0.130	0.141	0.919
Attitude towards sustainable farming	0.261*	0.127	2.051
Economic orientation	-0.039	0.148	0.260
Level of aspiration	-0.091	0.107	0.853
Farming commitment	0.296*	0.134	2.211
Scientific orientation	-0.049	0.286	0.171
Decision making pattern	0.421	0.215	1.350
Farm size	-0.506	0.476	1.064
Family education level	1.965	1.804	1.089
Sugarcane cultivation intensity	0.104	0.072	1.457
Socio economic status	0.129	0.148	0.874
Extension system link	0.325**	0.121	2.684
Research system link	0.383**	0.166	2.308

$R^2 - 0.6312$ 'F'-value: 11.01

* Significant at 0.05 level of probability (r > 1.960)
** Significant at 0.01 level of probability (r > 2.575)

4.13 PREDICTION OF INDEPENDENT VARIABLES CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Rainfed farmers

Null hypothesis

The few variables which contributed towards maximum variation cannot be delineated from the rest of the variables which have negligible cultivation towards the sustainability of sugarcane cultivation.

Empirical hypothesis

The scores on few variables which contributed maximum for variation could be delineated from the rest of the variables which have negligible contribution for variation in sustainability of sugarcane cultivation.

Table 41 shows the results of step down regression analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in sustainability of sugarcane cultivation.

It could be observed from the Table 41 that, there were five variables namely., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 60 per cent variation in sustainability of sugarcane cultivation. The F calculated value was found to be significant ($P < 0.05$). The contribution of above five variables contributed significantly positive.

Table 41: Step down regression analysis of personal, situational, psychological and communication factors of rainfed farmers on sustainability of sugarcane cultivation

Variables	'b' value	SE	't' value
Trainings undergone (X3)	0.5862	0.2469	2.374
Attitude towards sustainable agriculture (X5)	0.8152	0.3741	2.179
Extension system link (X15)	0.3710	0.1496	2.479
Research system link (X16)	0.2530	0.0972	2.602
	$R^2 = 0.6282$	F value = 4.1654	

4.14 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF IRRIGATED FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Correlation coefficients indicating the strength of relationship between independent and dependent variables are given in Table 42. The coefficients of correlation (r) have been tested for significance by calculating 't' value and comparing the 't' values with table values.

All the personal factors were found non significant with sustainability of sugarcane cultivation.

Among psychological variables, attitude towards sustainable agriculture, level of aspiration, farming commitment and decision making pattern were found positive and significant relationship with sustainability of sugarcane cultivation.

All the situational variables were found non significant with sustainability of sugarcane cultivation.

Both the communication variables were found significantly related with the sustainability of sugarcane cultivation.

4.15 CONTRIBUTION OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF IRRIGATED FARMERS WITH SUSTAINABILITY OF SUGARCANE CULTIVATION

Multiple linear regression analysis was carried out for all the sixteen independent variables against sustainability of sugarcane cultivation.

Table 42: Correlation co-efficient of selected independent variables of irrigated farmers with the sustainability of sugarcane cultivation

Variables	Correlation co-efficient
Education	0.000
Sugarcane cultivation experience	0.015
Trainings received	0.060
Achievement motivation	0.011
Attitude towards sustainable farming	0.212**
Economic orientation	0.018
Level of aspiration	0.212**
Farming commitment	0.361**
Scientific orientation	0.065
Decision making pattern	0.546**
Farm size	0.009
Family education level	0.027
Sugarcane cultivation intensity	0.039
Socio economic status	0.096
Extension system link	0.211**
Research system link	0.198*

* Significant at 0.05 level of probability ($r > 0.1285$)
** Significant at 0.01 level of probability ($r > 0.1684$)

Table 43 indicated that the variables namely trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link were found positively significant with sustainability of sugarcane cultivation.

The value of coefficient of multiple determination (R^2) was found to be 0.76, indicating that all the independent variables put together could explain variation in the dependent variable sustainability of sugarcane cultivation to the extent of 76.00 per cent.

The 'f' test of statistics indicated that the variation was significant at 5.00 per cent level of significance.

4.16 PREDICTION OF INDEPENDENT VARIABLES OF IRRIGATED FARMERS CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Null hypothesis

The few variables which contributed towards maximum variation cannot be delineated from the rest of the variables which have negligible cultivation towards the sustainability of sugarcane cultivation.

Empirical hypothesis

The scores on few variables which contributed maximum for variation could be delineated from the rest of the variables which have negligible contribution for variation in sustainability of sugarcane cultivation.

Table 44 shows the results of step down analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in the sustainability of sugarcane cultivation.

Table 43: Regression co-efficient of selected independent variables of irrigated farmers with the sustainability of sugarcane cultivation

Variables	b	Std. Error	t
Education	0.253	0.424	0.596
Sugarcane cultivation experience	0.355	-0.659	0.539
Trainings received	-0.697*	0.304	2.292
Achievement motivation	0.007	0.138	0.049
Attitude towards sustainable farming	0.312*	0.132	2.373
Economic orientation	-0.329	0.164	0.175
Level of aspiration	0.111	0.114	0.967
Farming commitment	0.276*	0.135	2.050
Scientific orientation	-0.031	0.378	0.081
Decision making pattern	0.040	0.235	0.169
Farm size	0.282	0.746	0.377
Family education level	0.119	1.460	0.081
Sugarcane cultivation intensity	-0.150	0.074	0.095
Socio economic status	-0.191	0.144	1.330
Extension system link	0.264*	0.131	2.012
Research system link	0.509*	0.219	2.326

$R^2 - 0.7610$ 'F'-value: 20.30

* Significant at 0.05 level of probability (r > 1.960)

** Significant at 0.01 level of probability (r > 2.575)

Table 44: Step down regression analysis of personal, situational, psychological and communication factors of irrigated farmers on sustainability of sugarcane cultivation

Variables	'b' value	SE	't' value
Trainings undergone (X3)	0.5857	0.2947	1.9874
Attitude towards sustainable agriculture (X5)	0.5283	0.2053	2.5721
Farming commitment (X8)	0.4537	0.2131	2.1283
Extension system link (X15)	0.0592	0.0296	1.9934
Research system link (X16)	0.6915	0.3361	2.057
	$R^2 = 0.7369$	F value = 7.5779	

It could be observed from Table 44 that, there were five variables namely., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 70 per cent variation in sustainability of sugarcane cultivation. The F calculated value may found to be significant ($P < 0.05$).

4.17 PROBLEMS AND SUGGESTIONS AS PERCEIVED BY THE FAMRERS REGARDING SUSTAINABILITY OF SUGARCANE CULTIVATION

4.17.1 Problems as expressed by the farmers

Results furnished in the Table 45 indicated that majority of the farmers had been facing some of the problems in practicing sustainable sugarcane farming. They were situational, input supply and services, technical and financial problems. Under situational problems namely lack of facilities for sett treatment for the control of smut and grassy shoot diseases, off-season drought during summer period. Under input supply and services, frequent power cut and inadequate supply of quality seed material from sugar factory. Under technical problems, lack of timely training on sustainable sugarcane farming practices, lack of knowledge about the use of micronutrients. Under financial, no crop insurance for sugarcane crop, low purchasing price offered by sugar factory.

4.17.2 Suggestions as given by the farmers

Based on these problems in sustainable sugarcane farming practices, as perceived by the farmers the following suggestions (Table 46) were offered for the sustainability of sugarcane cultivation.

Table 45: Problems as perceived by the farmers

(N = 240)

S No.	Situational	Frequency	Percentage	Rank
1	Lack of facilities for sett treatment for the control of smut and grassy shoot diseases	211	87.91	III
2	Off-season drought during summer period	216	90.00	II
3	Early cessation of rains from October onwards	10	4.16	XIV
4	High weed intensity	52	21.67	V
5	Problems of early shoot borer, scale insect etc.	226	94.16	I
6	Crop lodging	24	10.00	IX
7	Poor crop stand	13	5.41	XIII
8	Problem of water logging during monsoon season or lack of drainage facilities	27	11.25	VIII
9	Delay in harvesting and transporting to sugar factory	43	17.91	VI
10	Non-availability of high yielding late maturing varieties suitable to jaggery making	22	9.17	X
11	Improved implements are not available in the market	17	7.08	XI
12	Improved implements are into economical for small holdings	37	15.41	VII
13	Irregular supply of canal irrigation water	56	23.33	IV
14	Problematic soils	15	6.25	XII
Input supply and services				
1	Inadequate availability of organic manure	20	8.33	III
2	Inadequate supply of quality seed material from sugar factory	47	19.58	IV
3	Frequent power cut	208	86.67	I
4	Inadequate availability of labour	42	17.50	II

Table 45 contd...

S. No.	Situational	Frequency	Percentage	Rank
Technical				
1	Lack of timely training on sustainable sugarcane farming practices	19	7.91	III
2	Lack of knowledge about scientific method of judging maturity of cane	14	5.83	IV
3	Non availability of information on sugarcane production technology	9	3.75	
S. No.	Situational			
4	Lack of time and mobility problems to meet scientists and extensionsists	36	15.00	II
5	Lack of knowledge about the use of micro nutrients	62	25.83	I
Financial				
1	Inadequate availability of credit	44	18.33	VII
2	High cost of fertilizers and pesticides	170	70.83	V
3	Low purchasing price offered by sugar factory	209	87.08	I
4	Payment in installments to sugarcane growers by the factory management	201	83.75	III
5	High cost of seed material	196	81.67	IV
6	High wage rates	23	9.58	VIII
7	It requires more investment and not feasible for sustainance of sugarcane	19	7.91	IX
8	Micro nutrients are costly	72	30.00	VI
9	No crop insurance for sugarcane crop	208	86.67	II

Table 46: Suggestions by the farmers

(N = 240)

S. No.	Suggestions	Frequency	Percentage	Rank
1.	Sugar factory should provide facilities for sett treatment	201	83.75	II
2.	Good irrigation facilities should be provided	147	61.25	VIII
3.	Supply of pest and disease resistant varieties	183	76.25	III
4.	Immediate transplanting of the cane after harvesting.	157	65.41	VI
5.	Availability of suitable varieties for jaggery making	64	26.67	XIII
6.	Supply of organic manure	81	33.75	XI
7.	Regular supply of power	181	75.41	IV
8.	Awareness about use of micronutrients	73	30.41	XII
9.	Increase in purchasing price by the sugar factory	176	73.33	V
10.	Availability of quality seed material at lower price	152	63.33	VII
11.	Availability of micronutrients at lower price	29	12.08	XIV
12.	Implementation of crop insurance for sugarcane crop.	208	86.67	I
13.	Availability of organic manure	131	54.58	X
14.	More trainings on sustainable sugarcane farming practices	142	59.16	IX

4.18 PROBLEMS AND SUGGESTIONS AS PERCEIVED BY THE RESEARCHERS REGARDING SUSTAINABILITY OF SUGARCANE CULTIVATION

4.18.1 Problems as perceived by the researchers

From the Table 47, it could be noticed that inadequate supply of irrigation water from canals (84%), low feedback from extensionists (72%) and drought conditions (68%) are the major situational problems as expressed by the researchers.

Input supply and services

Frequent power cut (64%), Inadequate availability of organic manures (44%).

Technical

Sixteen per cent of the researchers expressed the identification of early maturing varieties (with high sucrose content) for quality retention under different months of planting and harvesting was the main technical problem.

Financial

No crop insurance for sugarcane crop was reported by 84 per cent of the researchers, as a major financial problem.

4.18.2 Suggestions given by the researchers

Cursory examination of the table 48 revealed that adopting drip irrigation (64%), need based fertilizer scheduling based on soil test results (32%) and minimum possible time gap between harvesting and cane processing to minimize sugar loss (24%) are the major suggestions given by the researchers.

Table 47: Problems as perceived by the researchers regarding sustainability of sugarcane cultivation

(N = 25)

S. No.	Situational problems	Frequency	Percentage	Rank
1	Inadequate supply of irrigation water from canals	21	84.00	I
2	Lack of transport facilities to visit farmer's fields	9	36.00	XI
3	Low feed back from extensionists	18	72.00	II
4	Lack of support from superiors	7	28.00	XIII
5	Delay in harvesting	12	48.00	VIII
6	Inadequate availability of labour	14	56.00	VI
7	Poor onset of monsoons	11	44.00	IX
8	Drought conditions	17	68.00	III
9	Less interaction with the officers in other organizations	15	60.00	V
10	Lack of training on recent advances	8	32.00	XII
11	Poor research infrastructure	5	20.00	XIV
12	Low to medium fertility status of the soils	16	64.00	IV
13	Late harvesting resulting in desiccation of plants	10	40.00	X
14	Poor crop stand	8	32.00	XII
15	Problem of water logging during monsoon season or lack of drainage facilities	13	52.00	VII
16	Problem of early shoot borer, scale insect etc.	17	68.00	III
II. Input supply and services				
1	Untimely supply of inputs and lab chemicals	6	24.00	III
2	Inadequate availability of organic manure	11	44.00	II
3	Frequent power cut	16	64.00	I
III. Technical				
1	Identification of early maturing varieties (with high sucrose content) for quality retention under different months of planting and harvesting	4	16.00	I
2	Mechanical harvesters even for small holdings	1	4.00	II
IV. Financial				
1	No crop insurance for sugarcane crop	21	84.00	I

Table 48: Suggestions by the researchers

(N = 25)

S. No.	Suggestions	Frequency	Percentage	Rank
1.	Adopting drip irrigation	16	64.00	I
2.	Activation of extension agencies at factory level and district level and training the extension staff at various aspects of sugarcane cultivation.	2	8.00	VI
3.	Trash mulching in rainfed sugarcane should be done to conserve moisture	4	16.00	IV
4.	Promotion of trash composting and Vermicomposting	2	8.00	VI
5.	Inclusion of sugarcane in crop insurance crops.	3	12.00	V
6.	Cultivation of early, mid and late varieties in right proportion	2	8.00	VI
7.	There should be proper prophylactic measures in order to minimize 90% of sugarcane diseases that spreads through setts like scale, pineapple disease, red rot, grassy shoot etc.	4	16.00	IV
8.	There must be a minimum possible time gap between harvesting and cane processing to minimize sugar loss.	6	24.00	III
9.	Assured market for jaggery	3	12.00	V
10.	Good minimum support price for sugarcane	3	12.00	V
11.	Development of varieties for waterlogged and drought conditions.	2	8.00	VI
12.	Adoption of stress management practices.	1	4.00	VII
13.	Development of varieties with quality retention for late harvesting.	1	4.00	VII
14.	Early planting of sugarcane may be encouraged in the areas prone for waterlogging	4	16.00	IV
15.	Need based fertilizer scheduling (based on soil test results)	8	32.00	II
16.	Sugarcane development department of each factory should keep a watch on the sudden occurrence of any new pest / disease and repeat the same to the research organizations for further examination.	2	8.00	VI

Table 48 contd...

S. No.	Suggestions	Frequency	Percentage	Rank
17.	Adoptive trials / on-farm trials may be taken up in each factory zone to popularize the management practices like IPM, INM, etc.	4	16.00	IV
18.	More financial assistance from the university for research.	1	4.00	VII
19.	Improvement in transport facilities to visit farmers fields.	2	8.00	VI
20.	Alternate cropping systems in place of existing crops with high water requirement.	1	4.00	VII
21.	Application of organic manures (FYM, green manure, vermicompost etc.) to increase fertility status.	3	12.00	V
22.	Adoption of integrated pest management	8	32.00	II
23.	Digging of more bore wells.	1	4.00	VII
24.	Installation of generators even for bore wells.	1	4.00	VII
25.	Scientists, farmers and officers from sugar factories and department of agriculture should regularly interact during kisan melas, ZREAC meetings etc.	2	8.00	VI
26.	Reclamation of saline and alkaline soils in the district.	2	8.00	VI
27.	Intercrops like greengram / blackgram should be taken up for improving soil productivity.	4	16.00	IV
28.	Thorough land preparation for a good tilth.	1	4.00	VII
29.	Proper ratoon cane management for higher cane and sugar yields.	3	12.00	V
30.	Credit facilities (in kind not in each).	1	4.00	VII

4.19 PROBLEMS AND SUGGESTIONS AS PERCEIVED BY THE EXTENSIONISTS REGARDING SUSTAINABILITY OF SUGARCANE CULTIVATION

4.19.1 Problems as perceived by the extensionists

A perusal of the Table 49 indicated that majority (90%) of the extensionists expressed non adoption of recommended agronomic practices like fertilization and irrigation, followed by non treatment of setts (86.67%) and indiscriminate use of fertilizers (73.33%) as situational problems.

"Frequent power cut" was reported by 56.67 per cent of the extensionists as major problem in input supply and services.

"No crop insurance for sugarcane crop" was expressed by 66.67% followed by inadequate availability of labour (50.00%) and inadequate availability of credit (46.67%) was expressed by the extensionists as the major financial problems.

4.19.2 Suggestions by the extensionists

From the Table 50, it could be noticed that sett material should be supplied through sugar factories (36.67%), crop insurance should be implemented (33.33%), steps should be initiated for continuous power supply (26.67%), improvement of irrigation facilities by digging big bore wells and deep wells (23.33%) are the major suggestions given by the extensionists.

Table 49: Problems as perceived by the extensionists regarding sustainability of sugarcane cultivation

(N = 30)

S. No.	I. Situational problems	Frequency	Percentage	Rank
1	Lack of transport facilities to visit farmers fields to get first hand information	18	60.00	VI
2	Late planting	13	43.33	VIII
3	Improper ratoon management	19	63.33	V
4	Improper land preparation	8	26.67	XIII
5	Shallow planting	6	20.00	XIV
6	Non adoption of recommended agronomic practices like fertilization and irrigation	27	90.00	I
7	Crop is subjected to water stress during summer	21	70.00	III
8	High weed intensity	9	30.00	XII
9	Problem of early shoot borer and scale insects etc.	20	66.67	IV
10	Planning is not done in stipulated periods	13	43.33	VIII
11	Non treatment of setts	26	86.67	II
12	Crop lodging	10	33.33	XI
13	Non availability of high yielding late maturing varieties suitable to jaggery making	12	40.00	IX
14	Low to medium fertility of the soils	14	46.67	VII
15	Low plant population	8	26.67	XIII
16	Non availability of improved implements for preparation of land	11	36.67	X
17	Late harvesting resulting in desiccation of plants	13	43.33	VIII
18	Poor crop stand	8	26.67	XIII
19	Problem of water logging during monsoon season or lack of drainage facilities	12	40.00	IX
II. Input supply and services				
1	Frequent power cut	17	56.67	I
III. Financial				
1	No crop insurance for sugarcane crop	20	66.67	I
2	Inadequate availability of credit	14	46.67	III
3	Low purchasing price offered by the sugar factory	11	36.67	IV
4	Inadequate availability of labour	15	50.00	II

Table 50: Suggestions by extensionists

(N = 30)

S. No.	Suggestions	Frequency	Percentage	Rank
1.	To improve the irrigation facilities by digging big bores and deep wells	7	23.33	IV
2.	Credit facilities for small and marginal farmers	4	13.33	VII
3.	Improvement of soil fertility.	4	13.33	VII
4	Providing managerial methods to small and marginal farmers.	1	3.33	X
5.	Sett treatment should be arranged in all factory zones.	11	36.67	I
6.	Sett material should be supplied through factories.	1	3.33	X
7.	Plant population, ratoon management should be improved.	4	13.33	VII
8.	Trash mulching for moisture retention.	2	6.67	IX
9.	Popularization of IPM and INM practices.	6	20.00	V
10.	Intercropping with greengram / blackgram / soybean in well drained normal soils.	3	10.00	VIII
11.	Green manuring before planting for improving soil health.	2	6.67	IX
12.	The period between cutting and crushing is to be reduced.	2	6.67	IX
13.	To maintain proper population, gap filling is required.	1	3.33	X
14.	Financial institutes should come forward to extent loan for agricultural implements, bore wells etc.	3	10.00	VIII
15.	Farmers to be educated on fertilization based on soil testing results.	4	13.33	VII
16.	Application of potassic fertilizers to be advocated to manage the crop in drought.	1	3.33	X

Table 50 contd...

S. No.	Suggestions	Frequency	Percentage	Rank
17	For ratoon crop, trash burn should be discouraged.	2	6.67	IX
18.	Technical trainings to be imparted at mandal level.	5	16.67	VI
19.	Steps should be initiated for continuous power supply.	8	26.67	III
20.	Crop insurance should be implemented.	10	33.33	II
21.	Adequate application of fertilizers and pesticides must be adopted.	3	10.00	VIII
22.	Latest technology should reach farmers from time to time.	4	13.33	VII
23.	Farmers training to be taken up.	2	6.67	IX
24.	Improved implements usage to be popularized for better tillage to the farmers by demonstration.	3	10.00	VIII
25.	Provide drip irrigation on subsidy basis.	2	6.67	IX
26	Provide improved implements on subsidy basis.	2	6.67	IX

Chapter - V

Discussion

CHAPTER – V

DISCUSSION

In this chapter, results are discussed for which contents of chapter IV used as base material. These findings are examined in relation to the reported findings of other investigations wherever possible.

5.1 Categorisation of the farmers according to personal, situational, psychological and communication factors.

5.2 Distribution of farmers according to the level of sustainability of sugarcane cultivation.

5.3 Distribution of rainfed farmers according to the level of sustainability of sugarcane cultivation.

5.4 Distribution of irrigated farmers according to the level of sustainability of sugarcane cultivation.

5.5 Distribution of farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation.

5.6 Distribution of rainfed farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation.

5.7 Distribution of irrigated farmers according to their level of sustainability in each of the indicators for sustainable sugarcane cultivation.

5.8 Difference in sustainability scores of rainfed and irrigated farmers.

5.9 Relationship of personal, situational, psychological and communication factors of farmers responsible for sustainability of sugarcane cultivation.

5.10 Contribution of personal, situational, psychological and communication factors of farmers on sustainability of sugarcane cultivation.

5.11 Prediction of independent variables of farmers contribution for maximum variation in sustainability of sugarcane cultivation.

5.12 Relationship of personal, situational, psychological and communication factors of rainfed farmers on the sustainability of sugarcane cultivation.

5.13 Contribution of personal, situational, psychological and communication factors of rainfed farmers on the sustainability of sugarcane cultivation.

5.14 Prediction of independent variables of rainfed farmers contribution for maximum variation in sustainability of sugarcane cultivation.

5.15 Relationship of personal, situational, psychological and communication factors of irrigated farmers on the sustainability of sugarcane cultivation.

5.16 Contribution of personal, situational, psychological and communication of actors of irrigated farmers on the sustainability of sugarcane cultivation.

5.17 Prediction of independent variables of irrigated farmers contribution for maximum variation in sustainability of sugarcane cultivation.

5.18 Problems and suggestions as perceived by farmers, researchers and extensionists.

5.19 Strategy to make sugarcane cultivation more sustainable

5.1 CATEGORISATION OF THE RESPONDENTS ACCORDING TO PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS

From the Table 2 it could be noticed that majority of the respondents had middle school education. Majority of the respondents were small and marginal farmers, could not go for higher education because of their financial problems and non-availability of higher educational facilities in their villages. Hence, efforts are needed to provide higher educational facilities and also educate the illiterate through adult education and functional programmes. This finding was in conformity with Baswarajaiah (2001) and Atchuta Raju (2001).

From the Table 3 it could be noticed that majority (27.50%) of the farmers had above 20 years of sugarcane cultivation experience followed by 15-20 years of experience (24.16%), 10-15 years of experience (23.33%), 5-10 years of experience (14.16%) and below 5 years of experience (10.85%). This trend might be due to the fact that younger generation has not choosen farming as a professiona nd it was continued by their parents only.

It could be noticed from the Table 4 that majority (68.75%) of the farmers had received medium trainings. Training programmes are generally conducted by the Research Stations and Sugar Factories. Training facilitates the farmers to acquire knowledge and skills involved in sugarcane cultivation. Number of programmes helps them in full adoption of technology. Therefore efforts are needed to organize more training programmes for the benefit of the sugarcane growers.

The data in the Table 5 depicts that majority (62.9%) of the farmers had medium achievement motivation followed by high and low achievement motivation. Achievement motivation mentally motivates human beings to act upon and compel

them to move toward and achieve their goals. This inner drive of farmers will be helpful in adopting sustainable sugarcane farming.

It is vivid from the Table 6 that majority (63.33%) of the farmers had favourable attitude towards sustainable agriculture followed by less favourable and more favourable. This trend might be due to the reason that majority of the sustainable sugarcane practices are more or less similar to traditional practices and majority of the farmers belonged to medium farming experience category.

It is clear from the Table 7 that majority (62.08%) of the farmers had medium economic orientation followed by high and low economic orientation. The economics and cost of cultivation of sugarcane to be worked out region-wise and agro-ecological zone wise by which the sugarcane farmers can be better convinced about the cost benefit ratio advantage by following sustainable sugarcane cultivation.

A cursory glance over the Table 8 depicted that majority (61.25%) of the farmers had medium level of aspiration followed by low and high level of aspiration. This trend might be due to the fact that majority of the farmers were more experienced since they were practicing farming from many years and reached the mid point of their life, hence their aspirational levels were found to be medium as most of them might have realized or failed in attaining their aspirations.

From the Table 9 it could be inferred that majority (60.41%) of the farmers had medium level of farming commitment followed by high and low farming commitment. The high commitment could be due to professional attachment and their inability to go for any other profession. This commitment should be exploited to adopt sustainable sugarcane cultivation. So, if they all convinced and shown the

beneficial effects of adopting sustainable sugarcane farming practices, the cost of production will come down drastically and quality of produce will also be enhanced.

It could be seen from the Table 10 that majority (71.66%) of the farmers possessed medium scientific orientation followed by low and high scientific orientation. The scientific bent of mind could be adopted by the extension agencies to convince the sugarcane farmers about the rationale to practice sustainable sugarcane farming practices.

A cursory glance over the Table 11 depicted that majority (64.16%) of the farmers had medium level of decision making pattern followed by high and low decision making pattern. This can be attributed for the awareness among sugarcane farmers about different sugarcane farming practices and their involvement in day to day farm operations.

Cursory examination of Table 12 revealed that majority (62.9%) of the farmers were small farmers followed by big and marginal farmers. This trend may be due to the fragmentation of the land from generation to generation. The results indicated their low socio economic profile, which influence the adoption pattern.

From the Table 13, it could be noticed that majority (90.84%) of the respondents had medium family educational level followed by high and low family educational level. This reason might be that majority of the sample consisted of and it is not possible for them to pursue higher studies due to financial insecurity prevailing among those households.

From the Table 14 it could be inferred that majority (69.58%) of the respondents observed under medium sugarcane cultivation intensity category. This

trend was due to the fact that majority of the farmers were growing sugarcane in larger proportion of their total farm size as it is the most chosen crop in that area.

Cursory examination of Table 15 revealed that majority (62.93%) of them had medium socio-economic status followed by high and low socio-economic status. This trend may due to the fact that majority of the sample selected for the study consisted of farmers who hail from rural areas and majority of them were small and marginal farmers and hence, the above relationship might have been observed.

From the Table 16 it could be inferred that majority (50.84%) of the farmers had medium extension system link followed by high and low extension system link. This trend may be due to the fact that extension system in the sampled area are put forthing only medium efforts. Hence there is evey need on the part of main extension agency to step up their efforts to achieve maximum number of sugarcane farmers under their extension reach for higher production and input use efficiency. Hence, above trend may be observed.

It could be observed from the Table 17 that majority (66.65%) of the farmers had medium research system link followed by low and high research system link. This trend is due to the fact that the research stations were not fully integrated with sugarcane farmers in prioritization of sugarcane research and dissemination of latest technical know-how. Hence, there is every need on the part of research institutes to work on location specific problems and disseminate knowledge.

5.2 DISTRIBUTION OF FARMERS ACCORDING TO THE LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION.

It is evident from the Table 18 that majority (65.84%) of the farmers had medium sustainable level followed by low and high sustainability level. This trend

might be due to the fact that sustainable sugarcane practices are appropriations of indigenous knowledge and hence are practicing but they have to be popularized by following appropriate extension strategy so that majority of sugarcane farmers realize their importance and adopt them on a large scale.

5.3 DISTRIBUTION OF RAINFED FARMERS ACCORDING TO THE LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

Cursory examination of the Table 19 revealed that majority (66.66%) of the rainfed farmers had medium sustainability level followed by low and high sustainability level. This trend is due to the fact that the sugarcane farmers were withdrawn from their traditional system of agriculture which they were practicing from time immemorial and now resorting to intensive agriculture and the same could be generalized to rainfed farmers who were poor in resources and technical know-how.

5.4 DISTRIBUTION OF IRRIGATED FARMERS ACCORDING TO THE LEVEL OF SUSTAINABILITY OF SUGARCANE CULTIVATION

From the Table 20 it could be revealed that majority (71.66%) of the irrigated farmers had medium level of sustainability followed by high and low sustainability level.

This trend is due to the fact that even though irrigated farmers who are assured of water are practicing intensive agriculture as on par with rainfed farmers with minor derivations, hence, irrespective of the type of farming whether irrigated or rainfed efforts should be made to popularise sustainable agricultural practices in sugarcane.

5.5 DISTRIBUTION OF FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS FOR SUSTAINABLE SUGARCANE CULTIVATION.

It is inferred from table 21 and Fig 23 that the eleven indicators for sustainable sugarcane cultivation were expressed in medium category by majority of sugarcane farmers as most of the Sustainable sugarcane cultivation practices were appropriations of indigenous knowledge and in order to elevate the level of indicators to high category by majority of farmers, a suitable strategy has to be devised with a multifaceted approach involving all the stakeholders and other organizations who work for conservation of ecology.

5.6 DISTRIBUTION OF RAINFED FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS FOR SUSTAINABLE SUGARCANE CULTIVATION

It is inferred from Table 22 and Fig 24 that majority of sugarcane farmers lie in medium level of indicators and followed by low and high levels as in dry land agriculture, the sustainable levels were further depleted due to poor management practices and other physiological constraints. The rainfed sugarcane farmers are the most vulnerable among farming community so, package of practices which were location specific and suitable for dry land have to be developed, refined and disseminated.

5.7 DISTRIBUTION OF IRRIGATED FARMERS ACCORDING TO THEIR LEVEL OF SUSTAINABILITY IN EACH OF THE INDICATORS FOR SUSTAINABLE SUGARCANE CULTIVATION

It is inferred from table 23 and Fig 25 that majority of irrigated farmers maintained medium level followed by high and low indicating a better position in

adoption of sustainable practices. They have to be motivated further to augment the usage of sustainable cultivation as they are free of constraints either physical or physiological so that success stories can be documented and disseminated among the farming community. This can be done by concentrating in areas which are deficient and involve skill and precision, which can be altered by replacing them with relevant practices which stood tests and performance.

The level of sustainability in all 11 indicators of sustainable sugarcane cultivation practices lie in the medium category followed by low or high or high or low with same exceptions. This finding clearly delineates that the farmers practicing some extent to admissible limits to sustainable cultivation practices but in order to elevate the level of sustainability to high category, a mass campaign has to be launched involving all stakeholders and ultimate beneficiaries by incorporating all suggestions given y the farmers, researchers and extensionists in the extension strategy that is going to be implemented.

5.8 DIFFERENCE IN SUSTAINABILITY SCORES OF RAINFED AND IRRIGATED FARMERS

5.8.1 Difference in sustainability scores of rainfed and irrigated farmers

It is evident from Table 24 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of sustainability. Further, when the means are compared between rainfed and irrigated farmers, it is evident that the mean sustainability score of irrigated farmers (56.92) was higher to that of rainfed farmers (42.43) indicating that the irrigated farmers had higher level of sustainability score than rainfed farmers.

5.8.2 Difference in scores of soil environment level of rainfed and irrigated farmers

It is evident from Table 25 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of soil environment level.

5.8.3 Difference in scores of ecosystem management of rainfed and irrigated farmers

It is evident from table 26 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of ecosystem management. Further, when the means are compared between rainfed and irrigated farmers, it is evident that the mean ecosystem management scores of irrigated farmers (61.11) were higher to that of rainfed farmers (43.72) indicating that the irrigated farmers had higher level of sustainability than the rainfed farmers.

5.8.4 Difference in scores of input use index of rainfed and irrigated farmers

It is evident from Table 27 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was significant difference between rainfed and irrigated farmers in respect of input use index. Further, when the means were compared between rainfed and irrigated farmers, it is evident that the mean input use index scores of irrigated farmers

(75.83) were higher to that of rainfed farmers (64.72) indicating that irrigated farmers had higher level of input use index than rainfed farmers.

5.8.5 Difference in scores of information self reliancy of rainfed and irrigated farmers

It is evident from Table 28 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of information self reliancy.

5.8.6 Difference in scores of input self sufficiency of rainfed and irrigated farmers

It is evident from Table29 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of input self sufficiency.

5.8.7 Difference in scores of integrated nutrient management of rainfed and irrigated farmers

It is evident from Table30 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of integrated nutrient management. Further, when the means were compared between rainfed and irrigated farmers, it is evident that the mean integrated nutrient management scores of irrigated farmers (73.71) were higher to that of rainfed farmers (62.13), indicating

that irrigated farmers had higher level of integrated nutrient management than rainfed farmers.

5.8.8 Difference in scores of integrated pest management of rainfed and irrigated farmers

It is evident from Table 31 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of integrated pest management.

5.8.9 Difference in scores of land productivity of rainfed and irrigated farmers

It is evident from Table 32 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of land productivity.

5.8.10 Difference in scores of input productivity of rainfed and irrigated farmers

It is evident from Table 33 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of input productivity. The calculated 'Z' value was compared with the table value.

5.8.11 Difference in scores of crop diversity of rainfed and irrigated farmers

It is evident from Table34 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that irrigated farmers were significantly differed with rainfed farmers in respect of crop diversity, might be due to their accord to resources and innovativeness.

5.8.12 Difference in scores of water management of rainfed and irrigated farmers

It is evident from Table 35 that the calculated 'Z' value was compared with the table value. It resulted in rejection of null hypothesis as the calculated value was significant at 0.01 per cent level of probability. This indicated that there was a significant difference between rainfed and irrigated farmers in respect of water management.

The relatively significant difference was observed for all sustainable indicators except input productivity clearly states that there is a lot of difference in sustainable cultivation between rainfed and irrigated areas of sugarcane. This finding is very useful involving a strategy for larger adoption of sustainable sugarcane farming practices so that irrigated and rainfed areas could be chalked out and developing location specific technologies which are cost effective and multifarious. The strategy has to be bifurcated regarding feedback, prioritization of research and dissemination of knowledge.

5.9 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL, COMMUNICATION FACTORS OF SUGARCANE FARMERS ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION

From the Table 36 it could be noticed that, there was a positive and significant relationship between education and sustainable sugarcane farming practices. Similar findings were observed by Jandhyala and Tilak (1930), Chandregowda (1996) and Lakshminarayana (2001).

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 eco-friendly farm practices. 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 practicing eco-friendly technologies, motivating the farmers to practice sustainable agriculture. Hence, the above relationship might have been noticed.

Sugarcane cultivation experience

There was a significant and positive relationship between sugarcane cultivation experience and sustainability of sugarcane cultivation. Similar findings were observed by Chandregowda and Jayaramaiah (1996), Karthikeyan *et al.* (1996) and Lakshminarayana (2001).

Farmers who have cultivated sugarcane since their early years must have been aware of the ill-effects of crossing nature's barriers, i.e., practicing 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, the above trend was observed.

Trainings received

There was a significant and positive relationship between trainings received and sustainability of sugarcane cultivation. Similar findings were observed by Himantharaju (1984) and Lakshminarayana (2001).

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 lending 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.

Achievement motivation

There was a positive and significant relationship between achievement motivation and sustainability of sugarcane cultivation. Similar findings were observed by Rao (1985), Chandregowda (1996) and Lakshminarayana (2001). However, these findings are not in line with the findings of Kumber (1983).

Achievement motivation is the important determinant of excellence or perfection in what one does. In order to achieve this distinction, farmers might have learnt the sustainable sugarcane farming practices meticulously and also might have adopted with adequate ease to maximize and sustain both yield and income from sugarcane crop. The danger with the use of agrochemicals like fertilizers and pesticides has gone to their minds and in fact 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 last of

basic resources. They have rationality and think in terms of maximizing income or status without affecting their resources or environment. Hence, the above trend might have been noticed.

Attitude towards sustainable farming

There was a positive and significant relationship between attitude towards sustainable agriculture and sustainability of sugarcane cultivation. Similar findings were observed by Chandregowda (1996), Rao (1997) and Lakshminarayana (2001).

The key attribute of an attitude is its evaluative component. That is, attitudes generally refer to individuals disposition to respond positively and negatively to same aspect / object. So, when a farmer possesses a favourable attitude towards sustainable farming, he would have, naturally, evaluated its positive and negative implication of practicing the same on his farm. As Bevy and Dunlop (1994) have proved in their attitude-behaviour relationship study, farmers attitude was the single most powerful variable that explained farmers' overall behaviour. 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, the above trend was observed.

Economic orientation

There was a significant and positive relationship between economic orientation and sustainability of sugarcane cultivation. Similar findings were observed by Reddy (1974), Chandregowda and Jayaramaiah (1996) and Lakshminarayana (2001)

Economic orientation 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 level of economic orientation, when one develops higher level of orientation and wants to achieve he could strive hard and get inter-relieved himself about different aspects of cultivation of sustainable sugarcane cultivation practices. Sugarcane farmers have perceived economic returns without damaging the basic resources and thus, have opted for sustainability of sugarcane cultivation. The fact that sustainable agriculture should also be economical is proved here. The farmers who are oriented 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, the above trend was observed.

Level of aspiration

There was a significant and positive relationship between level of aspiration and sustainability of sugarcane cultivation. Similar findings were observed by Chandregowda and Jayaramaiah (1996) and Lakshminarayana (2001).

The level of aspiration is closely related to achievement motivation, 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 each 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 part performance and experience. This might have acted as an added factor to better the sustainability of sugarcane cultivation. Hence, a significant relationship is observed between the level of aspiration and adoption level of sustainable farming practices.

Farming commitment

There was a significant and positive relationship between farming commitment and sustainability of sugarcane cultivation. The above finding is in agreement with the findings reported by Chandregowda (1996), Chandregowda and Jeyaramaiah (1996) and Lakshminarayana (2001).

Farming commitment is a test of dedication not only to reach a living but also keep the resource base alive and to keep 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, the above trend was observed.

Scientific orientation

Scientific orientation was not significantly correlated with sustainable sugarcane farming practices. As the sustainable sugarcane farming practices does not involve any complicated technology with higher precision as most of them are aggreviation of indigenous sugarcane production technology. Hence above relationship may be observed.

Decision making pattern

Decision making pattern is non significantly correlated with sustainability of sugarcane cultivation practices. This trend may be due to the fact that majority of the sugarcane farmers were least educated, resource poor and had not come out of the traditional rural set up. As regards decision making they were usually guided by orthodox mentality which is inherent in their rural set up. Hence, there is an urgent need on the part of extension agency to bring an attitudinal change for effective utilization of sustainable sugarcane farming practices.

This trend may be due to the fact that sustainability of sugarcane cultivation is an attitudinal aspect and nothing to do with farm size. Hence, the above relationship was observed.

Family educational level

This trend may be due to the fact that sustainable sugarcane practices are modification or appropriation of indigenous technology due to the advent of intensive agriculture, that the trend may be shifted. Hence; family educational level was nothing to do with sustainable sugarcane cultivation practices, but farmers have to be motivated by developing suitable extension strategy for increased adoption of sustainable sugarcane cultivation practices.

Sugarcane cultivation intensity

The variable sugarcane cultivation intensity positively correlated but not significant. It is quite natural that as both of them contrary to each other and increase intensity of sugarcane cultivation on large commercial basis create no reason for sustainable sugarcane practices.

Socio-economic status

There was a significant and positive relationship between socio-economic status and sustainability of sugarcane cultivation. Similar findings were observed by Wasnik (1993), Chandregowda (1996) and Lakshminarayana (2001).

Socio-economic status in the present study consists of four elements, mainly occupation, land holding, 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 practicing 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 longer 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, the above trend was observed.

Extension system link

There was a positive and significant relationship between extension system link and sustainability of sugarcane cultivation.

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 personnel. Farmers with a high level of extension personnel contact will consequently adopt the sustainable farming practices. Similar findings were observed by Chandregowda (1996), Karthikeyan *et al.* (1996), Shivaraj (1996) and Lakshminarayana (2001).

Participation in extension activities like demonstrations, 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.

Research system link

Sustainable sugarcane cultivation practices are need of the hour. Prioritisation of this aspect in agricultural research will lead to an increased sustainability of sugarcane cultivation. It results in low cost production, higher efficiency and a good cost benefit ratio.

5.10 CONTRIBUTION OF INDEPENDENT VARIABLES ON SUSTAINABILITY OF SUGARCANE FARMING

The regression analysis of the data in Table 37 shows that R^2 value is 0.6215, which indicates that 62.15 per cent of the sustainability of sugarcane cultivation was explained by 16 independent variables and the other 38 per cent by some other variables that were not included in the study. Among the selected variables, the variables namely trainings received, attitude towards sustainable farming, farming commitment, economic orientation, decision making pattern, family educational level, socio-economic status, extension system link and research system link were significantly contributing to the sustainability of sugarcane cultivation.

Since the personal, situational, psychological and communication factors (independent variables) have a contribution of 62 per cent on the adoption level of sustainable sugarcane farming practices, the hypotheses stating that the personal, situational, psychological and communication factors do not contribute for the adoption level of sustainable sugarcane farming practices is rejected. Therefore, the alternative hypotheses stating that personal, situational, psychological and communication factors have a contribution on the adoption level of sustainable sugarcane farming practices is accepted.

5.11 PREDICTION OF INDEPENDENT VARIABLES CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Table 38 shows the results of step down regression analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in sustainability of sugarcane cultivation.

It could be observed from the Table 38 that, there were five variables viz., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 61 per cent variation in sustainability of sugarcane cultivation. The F calculated value was found to be significant ($P < 0.05$). The contribution of above five variables contributed significantly positive.

5.12 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF RAINFED FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Education

There was a non significant relationship between education and sustainable sugarcane farming practices. This trend might be due to the fact that the modern education that is being taught in schools is away from nature and locale. It is unable to answer day to day questions especially pertaining to rural folk. Hence, it is necessary to impart or change or add in curriculum the concepts which includes the importance of eco-techniques and sustainable practices so that it will indicate the perils of ecological degradation.

Sugarcane cultivation experience

There was a non significant relationship between sugarcane cultivation experience and sustainable sugarcane farming practices. This trend was due to majority of the sugarcane cultivation is under intensive usage for many years and a farmer practicing intensive cultivation for many years tending to a good experience can not be immediately shifted to sustainable sugarcane farming practices.

Trainings received

There was a positive and significant relationship between trainings received and sustainable sugarcane farming practices. This trend might be due to the fact that trainings results in increased human caliber increased precision and overall improvement of human personality, when training is given in technological aspects like sustainable sugarcane farming practices certain it will result in increased sustainability of sugarcane cultivation.

Achievement motivation

This trend was higher achievement motivation will lead to exemplary performance in human endeavours but not necessarily be in the attitudinal aspects like sustainability of sugarcane cultivation.

Attitude towards sustainable farming

There was a positive and significant relationship between attitude towards sustainable farming and adoption of sustainable farming practices. This trend had a positive attitude towards sustainable farming certainly leads to sustainability of sugarcane cultivation.

Economic orientation

There was a non-significant relationship between economic orientation and sustainability of sugarcane cultivation. This trend might be due to the fact that farmers believed the surplus generated in terms of (Rupees) for both intensive and sustainable sugarcane cultivation might be same or sometimes intensive cultivation is generating higher returns. This trend is not due to the inherent efficiency of intensive sugarcane cultivation practices but inherent defect on the part of sugarcane

farmers to practice sustainable sugarcane cultivation on wider scale so that better monetary performs can be demonstrated and disseminated.

Level of aspiration

There was a non significant relationship between level of aspiration and sustainability of sugarcane cultivation. This trend might due to the fact that individual motives are different from community perceptions, hence, even though sugarcane farmers had medium to high aspiration levels it would not be reflected on conservation of nature and hence on sustainable sugarcane farming practices.

Farming commitment

There was a positive and significant relationship was observed between farming commitment and sustainability of sugarcane cultivation. Sugarcane farmers with greater commitment to farming stick to it even in times of controversy and difficulty and search suitable alternate ways to mitigate the situation. To avoid the consequences of intensive agriculture, they utilize some sustainable sugarcane farming practices. Hence, the above relationship was observed.

Scientific orientation

There was a non significant relationship between scientific orientation and sustainable sugarcane farming practices. As these practices are nearer to traditional practices and most of farmers lack required scientific temperament and hence the above relationship might have been observed.

Decision making pattern

There was a significant and positive relationship between decision making pattern and adoption of sustainable sugarcane farming. Collective decision making

would probably be oriented towards rational use of resources, the net effect being sustainable farming. Hence, the above trend was noticed.

Farm size

There was a non significant relationship between farm size and sustainable sugarcane farming practices. This trend may be due to the fact that sustainability of sugarcane cultivation is an attitudinal aspect and nothing to do with farm size. Hence, the above relationship was observed.

Family education level

There was a non significant relationship between family education level and sustainability of sugarcane cultivation. This trend may be due to the fact that sustainable sugarcane practices are modification or appropriation of indigenous technology due to the advent of intensive agriculture, that the trend may be shifted. Hence, family educational level was nothing to do with sustainable sugarcane cultivation practices, but farmers have to be motivated by developing suitable extension strategy for increased adoption of sustainable sugarcane cultivation practices.

Sugarcane cultivation intensity

There was a non significant relationship between sugarcane cultivation intensity and sustainability of sugarcane cultivation. It is quite natural that as both of them contrary to each other and increase intensity of sugarcane cultivation on large commercial basis create no reason for sustainable sugarcane practices.

Socio-economic status

There was a non significant relationship between socio economic status and sustainability of sugarcane cultivation. These adoption of these practices were

governed by awareness, cost-benefit, sensitivity to environment and has nothing to do with socio-economic status, hence, the above relationship might have been observed.

Extension system link

There was a significant and positive relationship between extension system link and sustainability of sugarcane cultivation. Participation of farmers in kisan melas, field trips, demonstrations and film shows etc. will increase the knowledge and thereby increase in sustainability of sugarcane cultivation. Similar findings were observed by Chandregowda (1996) and Atchutaraju (2002).

Research system link

There was a positive and significant relationship between research system link and sustainability of sugarcane cultivation. Farmer – scientist interaction increased the knowledge and there by increase in sustainability of sugarcane cultivation. Hence, the above relationship was observed.

5.13 CONTRIBUTION OF INDEPENDENT VARIABLES ON SUSTAINABILITY OF SUGARCANE FARMING

The regression analysis of the data in Table 41 shown that $R^2 = 0.63$ means 63 per cent of the sustainability of sugarcane cultivation is explained by 16 independent variables and the other 33 per cent by some other variables. Among the selected variables, the variables namely trainings received, attitude towards sustainable farming, farming commitment, extension system link and research system link were significantly contributing to the sustainability of sugarcane cultivation.

Since the personal, situational, psychological and communication factors (independent variables) have a contribution of 63 per cent on the adoption level of sustainable sugarcane farming practices, the hypotheses stating that the personal, situational, psychological and communication factors do not contribute for the adoption level of sustainable sugarcane farming practices is rejected. Therefore, the alternative hypotheses stating that personal, situational, psychological and communication factors have a contribution on the adoption level of sustainable sugarcane farming practices is accepted.

5.14 PREDICTION OF INDEPENDENT VARIABLES CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Table 41 shows the results of step down regression analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in sustainability of sugarcane cultivation.

It could be observed from the Table 41 that, there were five variables viz., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 62.82 per cent variation in sustainability of sugarcane cultivation. The F calculated value was found to be significant ($P < 0.05$). The contribution of above five variables contributed significantly positive.

5.15 RELATIONSHIP OF PERSONAL, SITUATIONAL, PSYCHOLOGICAL AND COMMUNICATION FACTORS OF IRRIGATED FARMERS ON SUSTAINABILITY OF SUGARCANE CULTIVATION

Education

This trend was due to higher education leads to good understanding, better comprehension and positive outlook. A simple extension effort can bring a drastic change towards enhanced adoption of sugarcane practices.

Sugarcane cultivation experience

There was a non significant relationship between sugarcane cultivation experience and sustainable sugarcane farming practices. This trend was due to majority of the sugarcane cultivation is under intensive usage for many years and a farmer practicing intensive cultivation a good experience can not be immediately shifted to sustainable sugarcane farming practices.

Trainings received

There was a significant and positive relationship between trainings received and sustainability of sugarcane cultivation. Similar findings were observed by Nagabhushanam (1997) and Atchuta Raju (2002). Generally during training programme, there was a wide scope to exchange of information and skills with fellow farmers were exposure of subject matter and knowledge from the training they received.

Achievement motivation

There was a non –significant relationship between achievement motivation and adoption of sustainable sugarcane cultivation practices. This trend might be due

to the fact that the resources rich farmers were preoccupied with other ventures and might have preferred farming as a secondary enterprise and hence the above relationship might have been observed.

Attitude towards sustainable farming practices

There was a positive and significant relationship was observed between attitude towards sustainable agriculture and sustainability of sugarcane cultivation. If a farmer having favourable attitude towards sustainable farming, then he will practice the sustainable farming. A favourable attitude to practice sustainable farming will make the farmers to acquire knowledge, utilize the available resources efficiently. Therefore the dependency on external inputs will be reduced. Hence, the above trend was observed.

Economic orientation

There was a non significant relationship observed between economic orientation an sustainability of sugarcane cultivation. This trend might be due to the fact that the irrigated farmers were not convinced about the surplus generate as a result of adoption of sustainable sugarcane farming practices or it would have been a smaller amount and hence the above trend might have been observed.

Level of aspiration

There was a significant relationship between level of aspiration and adoption sustainable sugarcane farming practices. This might be due to the fact that the irrigated farmers because of their resourcefulness were dynamic and energetic in their manaevoures. Even though they adopt sustainable sugarcane farming practices moderately, their aspirations were higher because of their natural tendency and this quality has to be exploited for augmenting the sustainability of sugarcane cultivation

Farming commitment

There was a positive and significant relationship between farming commitment and sustainability of sugarcane cultivation. This trend might be due to the fact that the irrigated farmers with fairly high commitment to farming can easily be convinced with meager extension efforts and they were certainly knowledgeable in traditional practices which are more or less similar to sustainable farming practices and this might have prompted them to adopt sustainable sugarcane farming practices

Scientific orientation

There was a non significant relationship between scientific orientation and sustainability of sugarcane cultivation. This trend might be due to the fact that majority of sustainable practices can be measured or evaluated in the long run only, as the benefits were clearly visible in the long run. The irrigated farmers with fairly high education levels and modern scientific temperament cannot concede to this fact. Hence, the above relationship might have been observed.

Decision making pattern

There was positive and significant relationship between decision making pattern and sustainability of sugarcane cultivation. This trend might be due to the fact that the farmers decisions to follow sustainable cultivation is the pivotal reason in the sustainability of sugarcane cultivation. Hence the above relationship might have been observed.

Farm size

There was a non significant relationship between farm size and sustainability of sugarcane cultivation. This trend might be due to the fact that irrigated farmers

irrespective of their farm size practice sugarcane farming which is more or less similar. Hence the above relationship might have been observed.

Family educational level

There was a non significant relationship between family educational level and sustainability of sugarcane cultivation. This trend might be due to the fact that the change management in farming is necessarily a social approach and has nothing to with individual family. Hence the above relationship might have been observed.

Sugarcane cultivation intensity

There was a non significant relationship between sugarcane cultivation intensity sustainability of sugarcane cultivation. This trend might be due to the fact that sugarcane cultivation intensity is the proportion of sugarcane area to the total cropped area which is owned by the individual farmer. It is a quantitative aspect and has nothing to do with sustainable sugarcane farming practices which is more of qualitative. Hence, above relationship might have been observed.

Socio economic status

There was a non significant relationship between socio economic status and sustainability of sugarcane cultivation. This trend might be due to the fact that socio economic status cannot discriminate against farmers who are practicing or non practicing sustainable cultivation as it is more economically oriented where as the sustainability of sugarcane cultivation lie in psychological domain of farmers. Hence, the above relationship might have been observed.

Extension system link

There was a positive and significant relationship between extension system link and sustainability of sugarcane cultivation has been observed. This trend might

be due to the fact that extension agencies play vital role in popularizing eco-technologies and even though because of any hurdles, they achieved commendable results. Hence the above relationship might have been observed.

Research system link

There was a positive and significant relationship between research system link sustainability of sugarcane cultivation. This trend might be due to the fact that research prioritization is the fundamental pre- requisite for achieving breakthrough in any aspect unless scientists were better apprised of farmer's perceptions regarding any particular technology, they could not design appropriate research objectives which are beneficial to the farmer who is the ultimate user of developed technology. Hence, the above relationship might have been observed.

5.16 CONTRIBUTION OF INDEPENDENT VARIABLES ON SUSTAINABILITY OF SUGARCANE FARMING

The regression analysis of the data in Table 43 shows $R^2 = 0.76$ that is, nearly 76 per cent of the sustainability of sugarcane cultivation is explained by 16 independent variables and the other 24 per cent is by some other variables. Among the selected variables, the variables namely trainings received, attitude towards sustainable arming, farming commitment, extension system link and research system link were significantly contributing to the sustainability of sugarcane cultivation.

Since the personal, situational, psychological and communication factors (independent variables) have a contribution of 76 per cent on the adoption level of sustainable sugarcane farming practices, the hypotheses stating that the personal, situational, psychological and communication factors do not contribute for the adoption level of sustainable sugarcane farming practices is rejected. Therefore, the

alternative hypotheses stating that personal, situational, psychological and communication factors have a contribution on the adoption level of sustainable sugarcane farming practices is accepted.

5.17 PREDICTION OF INDEPENDENT VARIABLES CONTRIBUTION FOR MAXIMUM VARIATION IN SUSTAINABILITY OF SUGARCANE CULTIVATION

Table 44 shows the results of step down regression analysis up to 11 steps predicting the most influential independent variables contributing for maximum variation in sustainability of sugarcane cultivation.

It could be observed from the Table 44 that, there were five variables viz., trainings received, attitude towards sustainable agriculture, farming commitment, extension system link and research system link explained about 76.39 per cent variation in sustainability of sugarcane cultivation. The F calculated value was found to be significant ($P < 0.05$). The contribution of above five variables contributed significantly positive.

5.18 PROBLEMS AND SUGGESTIONS AS PERCEIVED BY FARMERS, RESEARCHERS AND EXTENSIONISTS

5.18.1 Problems perceived by the farmers regarding the sustainability of sugarcane cultivation

It could be observed from the Table 45 that several problems were perceived by the farmers regarding the sustainability of sugarcane cultivation. Infestation of early shoot borer, scale insect etc., were the main problems as indicated by the 94.16 per cent of the respondents.

Ninety per cent of the respondents stated "off-season drought during summer period" as the problem.

"Lack of facilities for sett treatment for the control of smut and grassy shoot diseases" was reported by 87.91 per cent of the respondents.

The other problems identified by the respondents were low purchasing price offered by sugar factory (87.08%), frequent power cut and no crop insurance for sugarcane crop (86.67%), payment in installments to sugarcane growers by the factory management (83.75%), high cost of seed material (81.67%), high cost of fertilizers and pesticides (70.83%), etc.

Situational

It could be noticed from the table 45 that majority (94.16%) of the farmers were expressed the problems of early shoot borer, scale insect etc. Problem of early shoot borer and scale insects is increasing year after year tending to reduction in cane yields. Steps can be taken for control of these pests efficiently. In early shoot borer endemic areas, crop rotation on community basis avoids the problem to some extent. Measures like sett treatment, trash mulching and spraying with endosulfan will keep the pest under control.

Spraying with dimethoate at the rate of 2 ml per litre will control the scale insects. Spraying can be repeated at 15 day sinterval if necessary.

Ninety per cent 990%) of the farmers were expressed off season thought during summer period is the major problem. This problem is due to the lack of awareness about integrated farming. Soil inorganic matter can be replenished even with green leaf manuring and application of available FYM. Vermicomposting which is simple and low cost technology can be adopted to meet the manurial

requirements "Lack of facilities for sett treatment for the control of smut and grassy shoot diseases" was reported by 87.91 per cent of the respondents.

Input supply services

"Frequent power cut" was reported by 86.67 per cent of the respondents. In order to overcome this problem, supply of power should be regularized and the time schedule of power cut should be known to the needy farmers, so that they will adjust irrigation schedule as per the requirement. Sugarcane growing areas are to be kept in mind by the authorities concerned for the power cut and should be treated as equal as an industry.

"Inadequate availability of labour" was reported by 17.50 per cent of the respondents. Dependence on rain and taking plantings at a time by all the farmers in an area is the main cause for labour shortage under rainfed conditions.

Farm mechanization is the one and only measure to overcome labour shortage. Farm machinery like harvesters, weeders, fertigation equipment etc., are to be improved to later this need.

Technical problems

Lack of knowledge about the use of micronutrients was reported by 25.83 per cent of the respondents.

Financial problems

A large portion (87.08) of sugarcane farmers opined that low purchasing price offered by sugar factory is the main financial problem.

"No crop insurance for sugarcane crop" was expressed by 86.67 per cent of the farmers. Crop insurance for sugar crop has to be taken care of, otherwise the

area under sugarcane will came down. Keeping this in view, the measures are to be taken to implement crop insurance in sugarcane especially in rainfed conditions.

5.18.2 Suggestions given by the farmers

From the Table 46 it could be noticed that the respondents suggested certain solutions to overcome the problems foreseen in the sustainability of sugarcane cultivation.

5.18.2.1 Problems perceived by the researchers regarding the sustainability of sugarcane cultivation

Cursory examination of the Table 47 revealed that several problems were perceived by the researchers regarding the sustainability of sugarcane cultivation.

"Inadequate supply of irrigation water from canals" was the main problem as indicated by the 84.00 per cent of the researchers. Seventy six per cent of the respondents stated "no crop insurance for sugarcane crop".

"Low feedback from extensionists" was reported by 72.00 per cent of the researchers. The other problems identified by the respondents were drought conditions (68.00%), frequent power cut (64.00%), low to medium fertility status of the soils (64.00%), less interaction with the officers in other organizations (60.00%), inadequate availability of labour (56.00%), problem of water logging during monsoon season or lack of drainage facilities (52.00%), delay in harvesting (48.00%), inadequate availability of organic manures (44.00%), late harvesting resulting in decision of plants (40.00%), lack of transport facilities to visit farmer's fields (36.00%), etc.

5.18.2.2 Suggestions given by the researchers

From the Table 48 it could be noticed that the researchers suggested certain solutions to overcome the problems foreseen in the sustainability of sugarcane cultivation.

5.18.3.1 Problems perceived by the extensionists regarding the sustainability of sugarcane cultivation

It is evident from the Table 49 that several problems were perceived by the extensionists regarding the sustainable sugarcane farming practices.

"Non adoption of recommended agronomic practices like fertilization and irrigation was the main problem as indicated by the 90.00 per cent of the extensionists".

"Sett treatment not done" was reported by 86.67 per cent of the respondents. The other problems identified by the respondents were indiscriminate use of fertilizers (73.33%), late, untimely and heavy fertilizer application (73.33%), etc.

5.18.3.2 Suggestions given by the extensionists

From the Table 50 it could be noticed that the extensionists suggested certain solutions to overcome the problems foreseen in the sustainability of sugarcane cultivation.

5.19 STRATEGY TO MAKE SUGARCANE CULTIVATION MORE SUSTAINABLE

The different stakeholders involved in sugarcane farming from seed to seed must perform their new assigned roles for speedy sustainability of sugarcane cultivation.

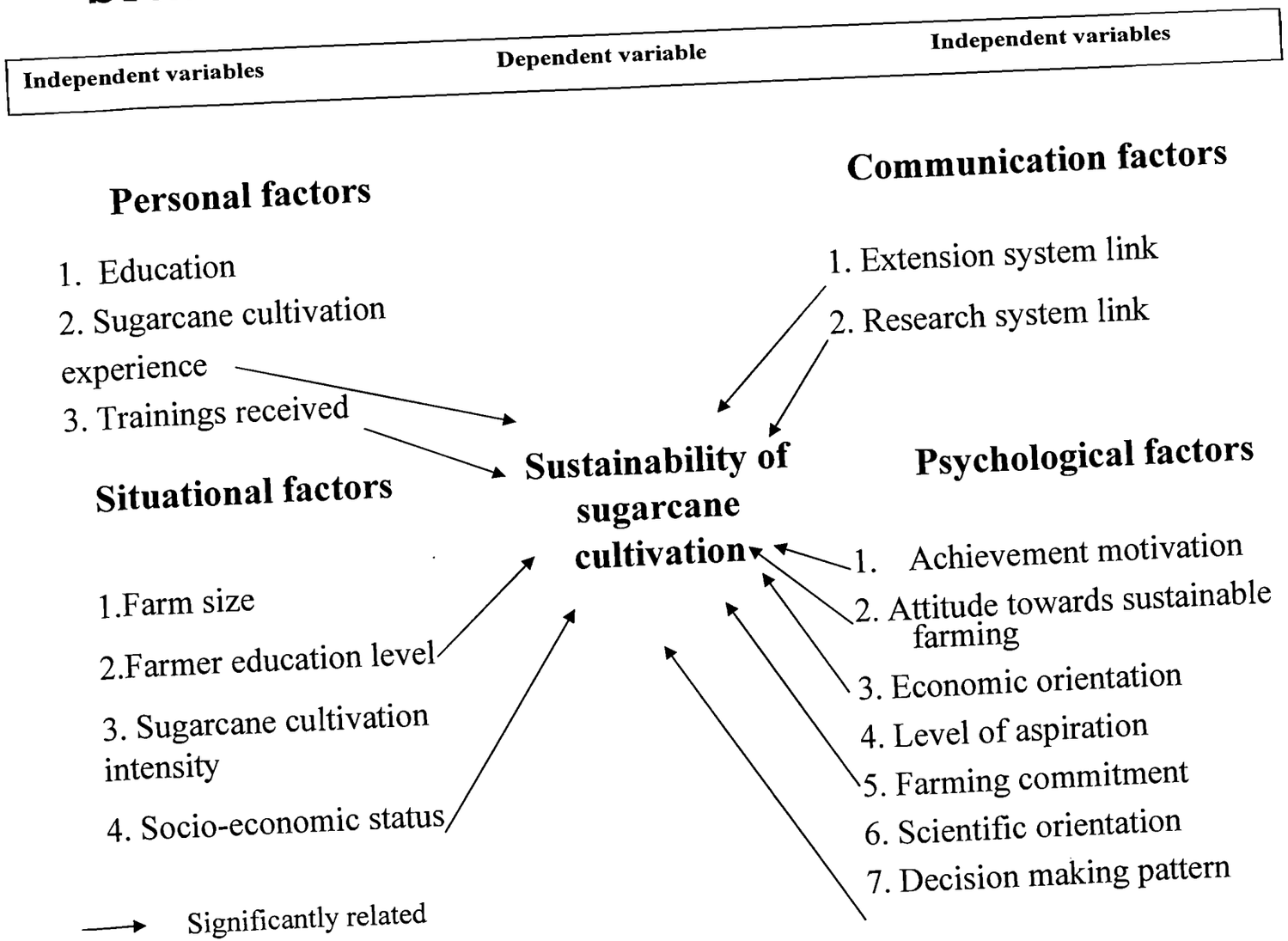
In order to provide in time technical guidance to the sugarcane farmers, the Farmers Field School (FFS) approach may be followed for promoting sustainable sugarcane development. In recent years, number of development agencies including World Bank promoted FFS as a more effective approach to extend science based knowledge and practices to the farming community. Farmers Field School is a practical way of diffusing knowledge intensive integrated pest management concepts and practices. The Farmers Field School training programmme utilizes participatory methods to help farmers develop their analytical skills, critical thinking and creativity and help them to learn better decision making. A group of farmers may be selected from the village and may meet once in a week for three to six hours. They participate in a series of activities including field monitoring, analysis and discussion on technical topics through group exercises. FFS provides an opportunity for these farmers to master the basic skills to make informed the field management decisions.

"To supply the quality sett material " was one of the suggestions spelt out by the respondents. Seed is the primary input for agriculture. Traditionally, farmers used to keep their own seed for next sowing. The post green revolution era witnessed a change in seed use with the adoption of new high yielding varieties and hybrids. Farmers started purchasing their seed requirement every year with the hope that the seed purchased from outside only give higher yields. The research and extension workers have not educated farmers on scientific way of producing their own seed. However the sugar factories have a great role in supplying quality sett material to the registered growers and other sugarcane producers. Hence it is the time that Transfer of Technology personnel of sugar factories, scientists of universities and other development workers teach the skills of seed production.

EMPIRICAL MODEL FOR THE STUDY

The conceptual model developed earlier for the purpose of this investigation was tested and based on the results empirical model was developed and presented in Fig. 23.

Fig.23: Empirical model showing the relationship between independent and dependent variables



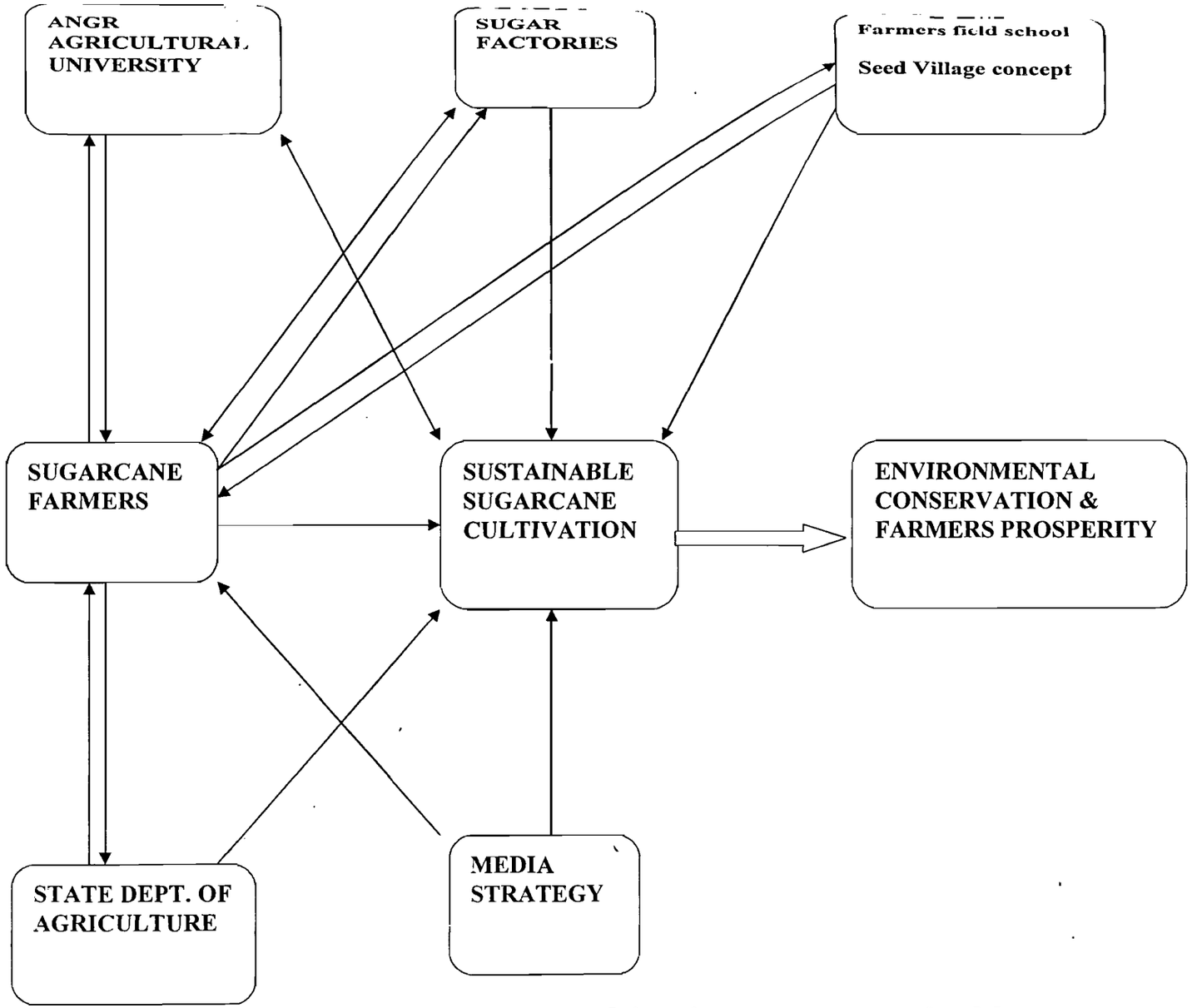


Fig.24:Strategy to make sugarcane cultivation more sustainable

Chapter - VI

Summary and Conclusions

CHAPTER – VI

SUMMARY AND CONCLUSIONS

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 and poor water management. The limitations of the modern agriculture has been recognized by the scientists and farmers allover 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 and insecticides.

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 purchase 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 will maintain the soil fertility intact and at the same time increase productivity.

There is a wide gap between the available sustainable sugarcane practices and its application in the field. The present study addresses itself to find out this gap and to develop suitable strategy to bridge the gap in the interest of resource base and environmental pollution.

OBJECTIVES OF THE STUDY

1. To find out the personal, situational, psychological and communication factors of sugarcane farmers
2. To develop an index to measure the sustainability of sugarcane cultivation
3. To measure the sustainability of sugarcane cultivation in rainfed and irrigated conditions
4. To ascertain the contribution of personal, situational, psychological and communication factors of farmers responsible for sustainability of sugarcane cultivation
5. To analyse the problems and suggestions as perceived by farmers, researchers and extensionists
6. To suggest a suitable strategy to make sugarcane cultivation more sustainable.

The study was conducted by following an ex-post-facto research design in Visakhapatnam district of Andhra Pradesh. By referring the Joint Directors of Agriculture, Office of Visakhapatnam district, sugarcane growing mandals were identified. Out of all irrigated and rainfed villages in each mandal, 2 irrigated and rainfed villages were selected by employing the random sampling method. Thus a total of 24 villages were selected for the study. Ten farmers from each village were selected randomly. Thus a total of 240 farmers from each village were selected randomly. All the twenty five scientists of RARS, Anakapalle were selected for the study. Thirty extensionists from Department of Agriculture and sugar factories were selected by employing proportionate stratified random sampling method.

Based on an extensive review of literature, discussion with experts and pilot study conducted in the area of investigation, sixteen independent variables covering personal, situational, psychological and communication profile of sugarcane farmers and one dependent variable namely sustainability of sugarcane cultivation are selected. A conceptual model of the study was developed.

An index was developed by using standard procedures while identifying components, working out scale values and then convincing them to arrive at sustainability index. This index was used to measure the sustainability of sugarcane farming. The data were collected through personal interview method using the schedule. The collected data were screened, tabulated and analysed keeping in view the objectives of the study.

Empirical measures were determined to quantify all the variables included in the conceptual framework. Appropriate structured schedule was developed for quantification of sustainability of sugarcane cultivation. Appropriate structured schedules were developed for quantification of trainings received, decision making pattern, family educational level, sugarcane cultivation intensity and research system link. For measuring education, scale developed by Trivedi (1963) with suitable modifications was used. Scale developed by Prasad (1983) was used for quantification of achievement motivation. For measuring attitude towards sustainable farming scale developed by Bues and Dunlop (1991) with suitable modification was used. Scale developed by Supe (1969) used for quantification of economic orientation, scale developed by Muthayya (1971) was used for measuring level of aspiration, scale developed by Gowda (1991) with suitable modifications was used for quantification of farming commitment. For measuring scientific orientation, scale developed by Supe (1969) was used.

A schedule was developed keeping in view, the objectives of the study and pre-tested in non-sample area and data were collected after establishing necessary rapport with the farmers.

The questionnaire was used for collecting the data from the scientists and agricultural officers. The data thus collected were tabulated and processed with the help of computer. The statistical tools used in the present investigation included mean, S.D., frequency, percentage, correlation, multiple linear regression, step down regression, 't' test, 'F' test and 'Z' test.

All the indicators of sustainability except input productivity index were found significant difference between rainfed and irrigated conditions.

The results thus emerged out of the study were presented below:

1. Majority of the farmers had middle school education. Majority of farmers were above 20 years of sugarcane cultivation experience, majority of farmers received medium level of training. However, there was positive significant relationship with achievement motivation, economic orientation, level of aspiration, farming commitment, scientific orientation, decision making pattern, family educational level, sugarcane cultivation intensity, socio-economic status, extension system link and research system link. Majority of the farmers had favourable attitude towards sustainable farming. Majority of the farmers had 2.5 to 5 acres of farm size.
2. Majority (65.84%) of the farmers comprising of both rainfed and irrigated belonged to medium level of sustainability group.
3. Majority (66.66%) of the rainfed farmers belonged to medium level of sustainability group.

4. Majority (71.66%) of the irrigated farmers belonged to medium level of sustainability group.

5. Majority of farmers had medium level of sustainability with respect to soil, environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

6. Majority of the rainfed farmers had medium level of sustainability with respect to soil environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

7. Majority of the irrigated farmers had medium level of sustainability with respect to soil environment level, ecosystem management, input use index, information self reliance, input self sufficiency, integrated nutrient management, integrated pest management, land productivity, input productivity, crop diversity and water management.

8. The independent variables of the farmers viz., education, sugarcane cultivation experience, training received, achievement motivation, attitude towards sustainable farming, economic orientation, farming commitment, decision making pattern, farm size, family educational level, socio economic status, extension system link and research system link had positive and significant relationship with sustainability of sugarcane cultivation.

9. The variables viz., training received, attitude towards sustainable farming, economic orientation, farming commitment, decision making pattern, farm size, socioeconomic status, extension system link and research system link were found positive and significant relationship with sustainability of sugarcane cultivation in rainfed conditions.

10. The variables like attitude towards sustainable agriculture, level of aspiration, farming commitment, decision making pattern, sugarcane cultivation intensity, extension system link and research system link were found positive and significant relationship with sustainability of sugarcane cultivation in rainfed conditions.

11. All the independent variables put together explained the variation in sustainability of sugarcane cultivation to the extent of 62.00 per cent.

12. All the independent variables put together explained the variation in sustainability of sugarcane cultivation in rainfed areas to the extent of 63.00 per cent.

13. All the independent variables of the farmers put together explained the variation sustainability of sugarcane cultivation in irrigated areas to the extent of 76.00 per cent.

Problems and suggestions as perceived by the farmers regarding sustainability of sugarcane cultivation

Lack of facilities for sett treatment for the control of smut and grassy shoot disease, off-season drought during summer period, frequent power cut, no crop insurance for sugarcane crop are the major problems as perceived by the farmers.

Implementation of crop insurance for sugarcane crop, sett treatment facilities by the sugar factory are the major suggestions given by the farmers.

Problems and suggestions as perceived by the researchers regarding the sustainability of sugarcane cultivation

Inadequate supply of irrigation water from canals, low feedback from extensionists, drought conditions are the major problems as perceived by the researchers.

Adopting drip irrigation, adoption of IPM and need based fertilizer scheduling are the major suggestions given by the researchers.

Problems and suggestions as perceived by the extensionists regarding sustainability of sugarcane cultivation

Non adoption of recommended agronomic practices like fertilization and irrigation, non treatment of setts are the major problems as perceived by the extensionists.

Sett material should be supplied through sugar factories, implementation of crop insurance, continuous proper supply are the major suggestions given by the extensionists.

IMPLICATIONS OF THE STUDY

1. Sustainable sugarcane cultivation can be practiced by farmers giving more consideration to organic manures, crop rotation, intercropping, water management, integrated pest management practices etc., to fight pests rather than chemical means of controlling pests.
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 and crop residues. These practices not only save money by reducing the use of inorganic fertilizers, but also improve the soil fertility.

3. Agricultural scientists, agricultural officers and cane inspectors of sugar factories should educate the farmers regarding the ill-effects of indiscriminate and imbalanced use of inorganic fertilizers.

4. For promoting sustainable agriculture, the agricultural scientists should develop more low cost and non-cash technologies. Adoption of low-cost and non-cash technologies in crop cultivation results in the reduction of production cost, thereby, lowering per unit cost of the output.

5. The findings of the study indicted that the variables like extension system link and research system link have made significant contribution to the sustainable sugarcane farming practices. Hence, Agricultural University, sugar factories and state department of agriculture need to provide basically the extension factors first and other factors be set in order to increase the adoption level of sustainable sugarcane farming practices.

As on now, sustainable practices are available i.e., in a piece-meal manner. There is a greater need for these sustainable sugarcane practices to be given to farmers in a package form. Effective linkage between research, extension and farming system should help in identifying the problems faced by farmers in the adoption of sustainable practices, ultimately arriving at the most appropriate solutions through on-farm research.

SUGGESTIONS FOR FUTURE RESEARCH

1. The present investigation was conducted in only Andhra Pradesh state. Similar studies may be undertaken in other concerned states of the country, so that inferences drawn can be generalized to a greater extent.

2. The evolved sustainability index has to be better use of in different 'crops based' or 'enterprise based' farming systems.

3. Further research may be conducted to investigate other specific factors that influence the sustainability of sugarcane cultivation.

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The pattern of 'Literature cited' presented above is in accordance with the 'Guidelines' for thesis presentation for Acharya N.G. Ranga Agricultural University, Hyderabad.

Appendices

ANNEXURE - I

A STUDY ON THE SUSTAINABILITY OF SUGARCANE CULTIVATION IN VISAKHAPATNAM DISTRICT OF ANDHRA PRADESH

PART – A

Name of the farmer : Age :

Village : Mandal :

I. INDEPENDENT VARIABLES

A. Personal Factor

S. No.	**Educational level**	
1	Illiterate	( )
2	Can read only	( )
3	Can read and write	( )
4	Primary	( )
5	Middle	( )
6	High school	( )
7	Intermediate	( )
8	Graduates and post graduates	( )

2. Experience in sugarcane cultivation _____ in years
3. Training received
   a) Have you undergone any training programme in sugarcane cultivation? Yes / No
   b) If yes, please indicate the training(s) undergone by you with duration

S. No.	Title of the training	Duration (No. of days)	Organizing institution
1			
2			
3			
4			

B. Psychological Factors

1. Achievement motivation

a)	1	Any farmer with ability and willingness to work hard has a good chance of success? If agree,	Agree/Disagree
	2	Do you think that you have succeeded as a farmer because of your hard work?	Yes / No
	3	Will you work still hard in future also to become a successful farmer?	Yes / No

b)	1	A farmer should use all his efforts in reaping a good harvest , if agree	Agree/Disagree
	2	Do you think that you had used all your efforts to get high yield from your crop?	Yes / No
	3	Don't you feel that you can get higher yields even if you do not put much efforts in raising crop?	Yes / No
c)	1	A farmer should utilize the available resources to boost his level of production? If agree,	Agree/Disagree
	2	Do you think that you are utilizing your land in the most efficient manner by adopting intensive practices?	Yes / No
	3	Will you try to raise more crops from the same piece of land you have?	Yes / No
d)	1	A farmer should plan to harvest higher yields and try to attain them, If agree,	Agree/Disagree
	2	Did you prepare any cropping plan for your land during the last year?	Yes / No
	3	Are you trying to increase the yield of your crops year after year?	Yes / No
e)	1	One should feel that you can achieve the things height wishes	Agree/Disagree
	2	Do you think that you have more or less succeeded in achieving all the things you wished?	Yes / No
	3	Do you feel that you can definitely achieve all the things you wish in the future also?	Yes / No
f)	1	A farmer should feel that no obstacle can stop him from reaping a harvest? If agree,	Agree/Disagree
	2	Don't you think that credit is a problem for you to purchase those inputs?	Yes / No
	3	Don't you think that pests and diseases will reduce the yields from your crops?	Yes / No
g)	1	One can really take a pride if the does his job well	Agree/Disagree
	2	Do you think that farmers can also be proud of their profession?	Yes / No
	3	Have you ever felt dissatisfied being a farmer?	Yes / No

h)	1	One should have to keep learning new skills for better management of the farm? If agree,	Agree/Disagree
	2	Have you participated in any training programme organized for the farmers?	Yes / No
	3	Do you want to participate in training programme for the farmers in future also?	Yes / No
i)	1	One should take part in competitions and try to perform better than others	Agree/Disagree
	2	Have you participated in any crop competitions conducted in your area?	Yes / No
	3	Will you avoid participating from crop competitions to be conducted in your area?	Yes / No
j)	1	One must provide good education to all the children? If agree,	Agree/Disagree
	2	Wont' you discourage your children from studying more and more?	Yes / No
	3	Do you want your children to attain higher educational status	Yes / No

2. Attitude towards sustainable farming

S. No.	Statements	Response categories				
		SA	A	N	D	SD
1	Sugarcane cultivation should be done so as to maximize profits even if it threatens long term productivity of land					
2	Large quantity of inputs should be used in sugarcane cultivation as long as it is profitable					
3	The primary goal of farmers should be to improve quality of the products in their farms					
4	Good sugarcane cultivation demands personal experience and better knowledge of the land					
5	Agricultural scientists and policy makers should recognize that there are to what nature provide and adjust their expectations accordingly					
6	Healthy rural communities are essential to make the sugarcane cultivation a success					

S. No.	Statements	Response categories				
		SA	A	N	D	SD
7	Farm traditions and culture use of little use in modern sugarcane cultivation					
8	Farming is first of all a way of life and then a business					
9	Farmers should use primarily synthetic fertilizers and pesticides in order to maintain adequate levels for production					
10	Most farmers should specialize either in livestock or crops					
11	Modern farming is a major course as ecological problems and must be greatly modified to become ecologically sound					
12	Crop rotations and diversifications are not essential for successful farming					
13	Farmers should produce as many as their own goods and services					
14	Soil and water are basic factors, production and should be exploited for longer production					
15	The key to initiate successful farming lies in learning to imitate natural economic system and farm in harmony with nature					
16	Farm labour should be replaced whenever possible by more efficient machines					
17	Processing and marketing of the produce is best done at local and regional level					
18	Farmers should cultivate as much land as they personally care for					
19	Most people should live in cities struggling all though life in farming					
20	The abundance of the production is an indicator of correcting of farming					

3. **Economic orientation**

S. No.	Statements	Response categories				
		SA	A	N	D	SD
1	A farmer should work towards higher yield and economic profits					
2	The most successful farmer is one who makes the most profit					
3	A farmers should try new farming idea which may earn him more money					
4	It is important for the farmer to have a good harvest in order to be able to buy many things besides food					
5	It is difficult for the farmer's children to make good start unless height can provide them economic assistance					
6	It is not only monitory profit but the employment work done which give a farmer satisfaction for his hard work in farming					

4. **Level of aspiration**

a) All of us want to provide education to our children but each one of us may differ with regard to the extent of the education that weight could expect our children to have what would be the level of education you expect?

		Your sons to have	Your daughters to have
1	No education		
2	Primary education		
3	Middle school		
4	High school		
5	College		
6	Technical / professional		

b) What would be the type of work you expect?

		Your sons to have	Your daughters to have
1	Agriculture		
2	Government job		
3	Professional or similar other		
4	Business		

c) What would be the type of house you expect to have in next three years?

1. No change
2. Katcha house (one roomed)
3. Katcha house (2 – 3 roomed)
4. Mixed house (partly pacca + partly katcha)
5. Pacca house (4-5 roomed)

d) What would you expect in land holding in next three years?

Increase by

1) No change
2) 1 acre
3) 2 –3 acres
4) 4 – 5 acres
5) 6 – 7 acres
6) 8 or more acres

e) What would you expect to be your general contentment (satisfaction) in life with in next 3 years

1. No change
2. Some what better
3. Certainly better than what it is
4. Very high contentment

f) What would you expect the position of your livestock (in terms of buffaloes/ cows or bulls) in the next 3 years

1. No change
2. One
3. 2 – 3
4. 4 – 5
5. 6 – 7
6. 8 and above

5. Farming commitment

S. No.	Statements	SA	A	N	D	SD
1*	If I were given a job in city, I quite sugarcane cultivation					
2	I feel that people simply talk f farming problems, but they forget that everything depends on how they mange it					
3*	I am not willing to take a great deal of effort to develop my farm					
4	I am prepared to face any problem to stay permanently in sugarcane cultivation					

S. No.	Statements	SA	A	N	D	SD
5*	I wish my children to be government employee rather than a sugarcane cultivation like me					
6*	There is not much to be gained by sticking to sugarcane cultivation permanently					
7	For me sugarcane growing is the best occupation when compared to other occupations					
8*	I continue sugarcane cultivation as it is not socially respected to sell my ancestral property					
9	I believe that sugarcane cultivation pays in long run viable returns					

* Negative statements

6. Scientific Orientation

S. No.	Statements	SA	A	N	D	SD
1	New method of farming gives better results to a farmer than older ones					
2	The way a farmer's, fore-fathers farmed is still the best way to farm today					
3	Even a farmer with lot of experience should use new methods of farming					
4	A good farmer experiences with new ideas of farming					
5	Traditional methods of farming have to be changed in order to raise the level of living of farmer					
6	Though it takes time for a farmer to learn new methods in farming it is worthy of the efforts					

7. Decision making pattern

S. No.	Practices	Head of family	Both parents	Parents and adult members
1	Selection of crop for sowing			
2	Selection of variety			
3	Seed treatment			
4	Manures and fertilizer application			
5	Plant protection measures			

S. No.	Practices	Head of family	Both parents	Parents and adult members
6	Soil and water conservation practices			
7	Hiring labour			
8	Weeding			
9	Marketing of produce			

III. SITUATIONAL FACTORS

1. Farm size (in acres) : Dry Wet Irrigated Dry Total
2. Educational level of the family
3. Sugarcane cultivation intensity
4. Socio-economic status

a) Type – Dry Irrigated / garden : Total

House

a) Katcha house

b) Mixed house

c) Pucca house

Number of houses :

Nature of family : Single Joint family

Size of family : Upto 5 members / Above 5 members

Farm power

1. Bullocks, bullock carts, wooden ploughs, sickles, spade
2. Sprayers, dusters, iron plough
3. Oil engines, electric motors

Material possession

1. Cycle, radio, chairs, tables, watch and fan
2. Sofa, almirah, iron cot
3. Motor cycle, TV

Occupation

1. Cultivation
2. Cultivation + subsidiary occupation
3. Cultivation + labour + subsidiary occupation
4. Cultivation + labour

Social participation

1. No membership in nay organization
2. Membership in one organization
3. Membership in more than one organization
4. Office bearer

IV. COMMUNICATION VARIABLES

1. Extension system link

a) Extension personnel contact

S. No.	Extension person	One in a week	Once in a fortnight	Once in a month	Once in a while	Never
1	AEO					
2	AO					
3	ADA					
4	DDA					
5	DAATTC scientists					

b) Participation in extension methods

S. No.	Methods	Regular	Occasional	Never
1	Demonstrations			
2	Kisan melas			
3	Training programmes			
4	Field days			
5	Field visits			
6	Education tours			

2. Linkage with research system

S. No.	Activities	Numbers
1	Correspondence with the research organization or with scientists directly	
2	Visit to the research station for a specific purpose	
3	Visit of scientists to the farmers field	
4	Attended or participated in exhibition / workshop / seminar / field day organized at research stations	
5	Taken up adaptive trials, front line demonstrations etc.	

PART – B

Sustainability of sugarcane cultivation

Soil environment level

1	Did you level the land?	Yes / No
2	Did you apply FYM in the last ploughing?	Yes / No
3	Did you apply green manure?	Yes / No
4	Did you apply fertilizer at recommended level	Yes / No
5	Did you apply nitrogen in split doses?	Yes / No
6	Did you test the soil for nutrient level? If yes, did you take remedial measures?	Yes / No
7	Did you adopt deep ploughing?	Yes / No
8	Did you apply vermin compost?	Yes / No
9	Did you use mulching on the soil?	Yes / No
10	Did you apply tank silt to the lands?	Yes / No

Ecosystem management

Mention the total land possessed by you _____ acres

How did you use the land for different crop cultivation (in acres)

a) Area under sugarcane _____
b) Area under food crops _____
c) Area under oil seed and other field crops _____
d) Area under fodder crops _____
e) Area under horticultural crops _____
f) Area under agro-forestry _____

Input use index

Please indicate the total quantity of inputs used during last year for sugarcane crop and mention how long these inputs are used

S. No.	Input	Quantity (kgs)	No. of years
1	Setts		
2	FYM/compost/ press mud cake		
3	Green manure / Green leaf manure		
4	Fertilizers :		

S. No.	Input	Quantity (kgs)	No. of years
5	Bio fertilizers		
6	Chemicals a) b) c) d)		
7	Labour (in No.)		
8	Others		

Information self rellancy

Indicate the extent of dependency for information in the following areas

S. No.	Information areas	Extent of dependency		
		Self	self and others	Others (specify)
1	Quantity of seed material			
2	Sett treatment			
3	Varieties			
4	Organic farming			
5	Planting density			
6	Time of fertilizer application			
7	Nature of fertilizers			
8	Quantity of fertilizers			
9	Method of application			
10	Identification of nutrient deficiencies			
11	Amending deficiencies			
12	Symptoms of damage of pests and diseases			
13	Identifying insects			
14	Controlling insects			
15	Identifying diseases			
16	Controlling diseases			
17	Weed management			
18	Water management			
19	Tillage and cultural equipment			
20	Ratoon management			

Give details about the quantity of inputs used, value of those inputs and the sources from where they were obtained

S. No.	Inputs used	Own resources		Purchased resources	
		Quantity (kgs)	Value	Quantity (kgs)	Value
1	Seed material (setts)				
2	FYM/compost/press mud cake				
3	Green manure/Green leaf manure				
4	Fertilizers				
5	Chemicals				
6	Human labour (in No.)				
7	Animal power				
8	Equipment				
9	Others, if any				

Integrated nutrient management

Have you tested your soils for nutrient status Yes / No

a) Organic manuring :

1. Did you apply FYM/compost/ press mud cake to sugarcane fields? Yes / No

If yes, what was the quantity?

2. When the FYM / compost/press mud cake was applied? _____ days before planting

3. How the FYM/compost / press mud cake was applied? Mixed into the soil Spread on the surface soil

4. Did you incorporate green manure to sugarcane fields? Yes / No

If yes, state whether

Green manure crop was raised *in situ*

Green leaf manure was brought from outside

5. When did you trample the green manure crop to soil? _____ days before planting

6. If the green manure was applied externally, what was the quantity? _____ tones

7. Did you apply any bio fertilizers/ If yes, please specify the type of bio fertilizer used

b) Inorganic manuring

1. Did you apply nitrogen in split dosess Yes / No

2. Did you apply phosphorus fertilizers as basal? Yes / No

3. Did you apply potassium in split doses? Yes / No

4. Give details of the nature and quantity of the fertilizers and time of application

S. No.	Name of fertilizers	Basal dose		Top dressing	
		Quantity (kgs)	Time	Quantity (kgs)	Time
1					
2					
3					
4					

5) How the basal dose was applied?

Mixed into the soil at the time of last ploughing applied on the surface of soil

6) Could you meet the full fertilizer requirements to all the plots? Yes / No

If no, the available fertilizer was

a) Equally distributed to all the plots ( )

b) Applied to all the plots but unequally ( )

c) Applied to some plots and not applied to other plots ( )

Integrated Pest Management

a) Prohylactic measures

1. Did you treat the setts with hot water at 52oC for 30 min. Yes / No

2. Did you spray the chemicals before appearing the pests and diseases? Yes / No

b) Curative measures

Mention the pests and diseases appeared on the crop and the nature of control measures taken

S. No.	Pests and diseases appeared	Control measures taken
1.	Pests a) b) c) d)	
2.	Diseases a) b) c) d)	

3. a) Did you attend the manual weeding? Yes / No

If yes, how many times attended _____ Nos.

b) Have you used weedicide? Yes / No

If yes, name the weedicide _____

Quantity of weedicides used _____ kg

Land productivity

Could you please recall the total quantity of sugarcane produced on your farm from the past 3 years

S. No.	Year	Area under sugarcane	Total quantity of sugarcane produced (tonnes)
1	2000		
2	2001		
3	2002		
	Total		

Input productivity :

1. Total quantity of sugarcane produced during 2001-02
2. Value of the total produce in Rs. _____
3. Total cost of production

$$P = \frac{\text{Value of the output}}{\text{Total cost of production}}$$

Crop diversity

Give details of the crops grown during the years from the years 2000 to 2002

Year	S. No.	Crop	Variety	Area	Yield (qtls.)
2000	1				
	2				
	3				
2001	1				
	2				
	3				
2002	1				
	2				
	3				

Water management

1	Have you kept your sugarcane plots perfectly leveled?	Yes / No
2	Did you prepare the lands properly before planting of sugarcane sets?	Yes / No
3	Whether you are giving irrigations in furrows or in alternate furrows?	Yes / No
4	Do you maintain adequate moisture in the field after incorporating organic manure?	Yes / No
5	Did you irrigate after the application of fertilizer as top dressing?	Yes / No
6	Did you stop flow of water from plot to plot after applying fertilizers?	Yes / No
7	Did you prepare 45 cm deep and 60 cm wide drainage channels at 24 mts apart?	Yes / No
8	Did you give irrigation once in six days in summer?	Yes / No
9	Did you give irrigations once in 15 – 21 days from Nov to harvest	Yes / No
10	Did you give 1-2 irrigations during rainy seasons if dry spells prevail?	Yes / No
11	Did you adopt trash mulching 3 days after planting?	Yes / No
12	Did you give 3 irrigations before monsoon begins?	Yes / No
13	Is your soil salt affected?	Yes / No
	If Yes, did you reclaim your soil	Yes / No

PART – C

Please mention the problems as perceived by you regarding the sustainability of sugarcane cultivation

I. SITUATIONAL

1. Lack of facilities for sett treatment for the control of smut and grassy shoot diseases
2. Off-season drought during summer period
3. Early cessation of rains from October onwards
4. High weed intensity
5. Problems of early shoot borer scale insect etc.
6. Crop lodging
7. Poor crop stand
8. Problem of water logging during monsoon season or lack of drinage facilities
9. Delay in harvesting and transporting to sugar factory
10. Non-availability of high yielding late maturing varieties suitable to jaggery making
11. Improved implements are not available in the market

12. Improved implements are not economical for small holdings
13. Irregular supply of canal irrigation water
14. Problematic soils

II. INPUT SUPPLY AND SERVICES

1. Inadequate availability of organic manure
2. Inadequate supply of quality seed material from sugar factory
3. Frequent power cut
4. Inadequate availability of labour

III. TECHNICAL

1. Lack of timely training on sustainable sugarcane farming practices
2. Lack of knowledge about scientific method of judging maturity of cane
3. Non availability of information on sugarcane production technology
4. Lack of time and mobility problems to meet scientists and extensionists
5. Lack of knowledge about the use of micro nutrients

IV. FINANCIAL

1. Inadequate availability of credit
2. High cost of fertilizers and pesticides
3. Low purchasing price offered by sugar factory
4. Payment in installments to sugarcane growers by the factory management
5. High cost of seed material
6. High wages rates
7. It requires more investment and not feasible for sustenance of sugarcane
8. Micro nutrients are costly
9. No crop insurance for sugarcane crop

Any other please specify

Please offer suggestions to overcome the above problems

1.
2.
3.
4.
5.
6.

ANNEXURE - II

QUESTIONNAIRE FOR RESEARCHERS

Name: Designation: Place:

Please tick ( ) the problems as perceived by you regarding the sustainability of sugarcane cultivation

I. SITUATIONAL

1. Lack of facilities for sett treatment for the control of smut and grassy shoot diseases
2. Off-season drought during summer period
3. Early cessation of rains from October onwards
4. High weed intensity
5. Problems of early shoot borer scale insect etc.
6. Crop lodging
7. Poor crop stand
8. Problem of water logging during monsoon season or lack of drinage facilities
9. Delay in harvesting and transporting to sugar factory
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1. Inadequate availability of organic manure
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1. Lack of timely training on sustainable sugarcane farming practices
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3. Non availability of information on sugarcane production technology
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IV. FINANCIAL

1. Inadequate availability of credit
2. High cost of fertilizers and pesticides
3. Low purchasing price offered by sugar factory
4. Payment in installments to sugarcane growers by the factory management
5. High cost of seed material
6. High wages rates
7. It requires more investment and not feasible for sustenance of sugarcane
8. Micro nutrients are costly
9. No crop insurance for sugarcane crop

Any other please specify

Please offer suggestions to overcome the above problems

1.
2.
3.
4.
5.
6.

ANNEXURE - III

QUESTIONNAIRE FOR EXTENSIONISTS

Name: Designation: Place:

Please tick ( ) the problems as perceived by you regarding the sustainability of sugarcane cultivation

I. SITUATIONAL

1. Lack of facilities for sett treatment for the control of smut and grassy shoot diseases
2. Off-season drought during summer period
3. Early cessation of rains from October onwards
4. High weed intensity
5. Problems of early shoot borer scale insect etc.
6. Crop lodging
7. Poor crop stand
8. Problem of water logging during monsoon season or lack of drinage facilities
9. Delay in harvesting and transporting to sugar factory
10. Non-availability of high yielding late maturing varieties suitable to jaggery making
11. Improved implements are not available in the market
12. Improved implements are not economical for small holdings
13. Irregular supply of canal irrigation water
14. Problematic soils

II. INPUT SUPPLY AND SERVICES

1. Inadequate availability of organic manure
2. Inadequate supply of quality seed material from sugar factory
3. Frequent power cut
4. Inadequate availability of labour

III. TECHNICAL

1. Lack of timely training on sustainable sugarcane farming practices
2. Lack of knowledge about scientific method of judging maturity of cane
3. Non availability of information on sugarcane production technology
4. Lack of time and mobility problems to meet scientists and extensionists
5. Lack of knowledge about the use of micro nutrients

IV. FINANCIAL

1. Inadequate availability of credit
2. High cost of fertilizers and pesticides
3. Low purchasing price offered by sugar factory
4. Payment in installments to sugarcane growers by the factory management
5. High cost of seed material
6. High wages rates
7. It requires more investment and not feasible for sustenance of sugarcane
8. Micro nutrients are costly
9. No crop insurance for sugarcane crop

Any other please specify

Please offer suggestions to overcome the above problems

1.
2.
3.
4.
5.
6.

EXTENSION EDUCATION INSTITUTE
Acharya N.G. Ranga Agricultural University
Rajendranagar, Hyderabad 30
Phone: (0) 4015368
4010549

Dr. A.B. Sankara Rao
Associate Professor

Dated:16-11-2002

Dear Sir / Madam

I am glad to inform hat Mr. G.S. Roy a senior Ph.D scholar of Agricultural Extension is persuing a research study entitled 'A study on the sustainability of sugarcane cultivation in Visakhapatna district of A.P." under my guidance. As part of the study, the scholar trying to develop an index to measure the sustainability of sugarcane cultivation.

In this connection, components of sustainable sugarcane cultivation have been enlisted in the Annexure based on review of literature and discussion with a experts. Considering your high academic qualifications and rich experience pleased to seek your vluable judgment on the relevancy of these components. The operational meanings of each of these components used also provided along with the operational meaning of sustainability of sugarcane cultivation to facilitate your judgment.

Please make specific judgment on the relevancy of these components on four point continuum, by tick ( ) mark and also suggest any other pertinent item (s) that you consider as relevant to sustainability of sugarcane cultivation.

I, therefore, request you to kindly spare some of your valuable time and help the scholar in the research.

With kind regards,

Yours sincerely,

(A.B. SANKARA RAO)

To

ANNEXURE - IV

Sustainability of sugarcane cultivation is the process by which farmer manages soil and water relying mainly on on-farm resources to enhance productivity without affecting the production environment.

Sl. No.	Indicators of sustainability of sugarcane cultivation	Relevancy			
		Most relevant	Rele-vant	Some what relevant	Not rele-vant
1.	Soil Environment Level: It is the extent of adoption of different soil and water conservation practices to protect the fertility level of soil				
2.	Ecosystem management: It is the extent to which the farmers adopt the different biomass production practices to maintain the congenial ecosystem				
3.	Input Use Index: It is the level of adoption of the production inputs for the crops grown by the farmers as against the recommended level to sustain the crop production				
4.	Information self reliancy: It is operationalised as the ability of the farmer to possess information required for successful sugarcane farming and to rely upon that at the time of decision making.				
5.	Input self sufficiency: It is operationalised as the extent to which farmer was able to meet the input requirement of sugarcane farming from own resources than the purchased inputs.				
6.	Input productivity: It is considered as output per unit of input used. It was expressed as the ratio of gross output to the total variable cost.				
7.	Indigenous knowledge utility: Extent to which farmers use indigenous knowledge for successful management of resources in agricultural practices.				
8.	Integrated Nutrient Management: Nutrient management is operationalised as 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.				

9. Integrated Weed Management
A weed management system that uses all suitable control methods in a compatible manner, to reduce weed population and maintain them at levels below those causing economic injury.

10. Integrated Pest Management:
It is operationalised as the management of pests (insects, diseases and weeds by using preventive and curative measures through judicious combination of cultural, mechanical, biological and chemical means.

11. Crop yield security:
Crop yield security was operationalised as the extent to which farmers manage sugarcane crop so as to withstand the external crisis may be due to excess or shortage of rainfall, outbreak of pest, non availability of inputs and inability of the farmer to take up timely operations.

12. Crop diversity:
It is the change in crops and cropping pattern followed by the farmers in order to protect the productivity of land.

13. Crop productivity:
It refers to the ratio between the yield of crops obtained with that of expected yield levels.

14. Land productivity
Land productivity is operationalised as yield pe runit area, expressed in terms of tonnes/ha. Land productivity was taken as the average of the past 3 crops to give weightage to productivity over a period of time.

15. Enterprise supporting ability
It is the level of maintaining the different subsidiary enterprises to sustain the economic levels of farmers.

16. Water management
Water management was operationalised as the application of practices to obtain added benefits from rainfall and water flow through irrigation for crop production with a proper drainage to keep the soil health intact.

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
Extension Education Institute
Rajendranagar, Hyderabad 500 030

Dr. A.B. Sankara Rao
Professor

Dated:3-3-2003

Sir,

Mr. G.S. ROY, Ph.D. scholar in Agricultural Extension is trying to develop an index to measure sustainability of sugarcane cultivation as part of his research work under my guidance. Fifty judges have identified the following eleven dimensions as indicators of sustainable sugarcane cultivation (Annexure). Now you are requested to rate these indicators for their importance in measuring sustainability, on an eleven point ranking scale. Your rating is required to assign relative weightages to each indicator. Please give the appropriate rank number. First rank indicates highest importance and the eleventh rank indicates least importance.

Please devote a little bit of your valuable time in helping the researcher to proceed further.

Thanking you,

Yours sincerely,

(A.B. SANKARA RAO)

To

ANNEXURE - V

Sl. No.	Indicators of sustainable sugarcane cultivation	Rank
1.	Soil environment level	
2.	Ecosystem management	
3.	Input use index	
4.	Information self reliancy	
5.	Input self-sufficiency	
6.	Input productivity	
7.	Integrated nutrient management	
8.	Integrated pest management	
9.	Crop diversity	
10.	Land productivity	
11.	Water management	

ANNEXURE - VI

RELEVANCY COEFFICIENTS OF INDICATORS OF SUSTAINABILITY INDEX OF SUGARCANE CULTIVATION

Sl. No.	Indicator	Relevancy coefficient
1.	Soil environment level	0.78
2.	Ecosystem management	0.75
3.	Input use index	0.75
4.	Information self reliancy	0.78
5.	Input self-sufficiency	0.75
6.	Input productivity	0.81
7.	Indigenous technical knowledge	0.59
8.	Integrated nutrient management	0.85
9.	Integrated pest management	0.89
10.	Integrated weed management	0.56
11.	Crop yield security	0.56
12.	Crop diversity	0.72
13.	Crop productivity	0.53
14.	Land productivity	0.91
15.	Enterprise supporting ability	0.54
16.	Water management	0.85