COMPARATIVE ANALYSIS OF SUSTAINABILITY OF RICE AND SUGARCANE FARMING SYSTEM IN SHIMOGA DISTRICT

NAGENDRA RAO Y.

DEPARTMENT OF AGRICULTURAL EXTENSION
UNIVERSITY OF AGRICULTURAL SCIENCES
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NAGENDRA RAO Y.

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University of Agricultual Sciences, Bangalore

CERTIFICATE

This is to certify that the thesis entitled a ***COMPARATIVE ANALYSIS OF SUSTAINABILITY OF RICE AND SUGARCANE FARMING SYSTEM IN SHIMOGA DISTRICT*** *submitted by* ***Mr. NAGENDRA RAO. Y*** *for the degree of* ***MASTER OF SCIENCE [AGRI] in EXTENSION EDUCATION*** *of the University of Agricultural Sciences, Bangalore is a record of research work done by him during the period of his study in this university under my guidance and supervision and the thesis has not previously formed the basis of the award of my degree, diploma, associateship, fellowship or other similar titles.*

Bangalore
, February, 1997.

(Dr. N R. GANGADHARAPPA)
Assoc. Prof. of Agril. Extn.

APPROVED BY :

Chairman : ----------
(Dr. N.R.GANGADHARAPPA)

Members : 1.----------
(Prof VENUGOPAL).

2. ----------
(Dr . M . SHIVAMURTHY)

3. ----------
(Mr .G. B. MALLIKARJUNA)

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Introduction

I INTRODUCTION

Agriculture, the primary activity in every society, is having extremely critical role to play in sustaining life of living beings. Activities in the soil, which enable agricultural produce to grow, are therefore exceedingly important to living beings. Agriculture as practiced at present, is considered as a serious polluter of environment. The science based research and extension have focused on 'modern agriculture' with high level of external inputs, namely, agro-chemicals, hybrid seeds, fuel based mechanisation etc. The primary aim of their efforts has been to increase the yields of crops like rice, wheat, maize and commercial crops.

Population , growing at an increasing rate, pushes up demand for food and therefore the "Green Revolution" came to the rescue of the world including our country. Agriculture became an industry to maximise production with least cost. This kind of agriculture is associated with the declining soil productivity, deteriorating environmental quality, reduced profitability and ultimately threats to human and animal health.

Farmers have started realising the damage to the society in following the practice of maximising artificial inputs etc., and are increasingly turning over to other practices which are not being termed as natural farming, organic farming, zero tillage, zero or minimum input farming. Now, we are using the term "Sustainable Agriculture" to cover different non-conventional practices.

Traditional agriculture, though the locally available seeds, organic manure and the traditional agricultural implements does not harm the environment and maintains

environmental balance but gives very low yield and do not fulfill the growing needs of people. Thus there is need to introduce such a system which will provide sustainability in agriculture [Muthuraman, 1995]

Sustainable agriculture endeavours to tackle many serious problems afflicting world food production, high energy costs, groundwater contamination, soil erosion, loss of productivity, depletion of fossil resources , low farm income and risk to human health and wild life habitats. It is not so much a specific farming strategy as it is a system approach to understanding the complex interactions within agricultural ecologies. Hence, there is need for sustainable agriculture [Ketan mehta, 1995].

By 2000 AD, our country's population reaches one billion and foodgrains requirement would be 230 m.t. against the present level of 170 m.t. (Surekha. & Rao., 1995) . So, there is an urgent need to increase the production of foodgrains and other crops and at the same time we must protect production environment like soil, water and air at safer level for future generation.

Agricultural sustainability was not a major issue in the 1960's and 1970's , because food production resources did not appear threatened by over use. But today sustainability has become a significant issue in the world . A number of scientists and layman have realised their concern about conservation of environment .

In 1987, the World Commission on Environment and Development (WCED) has said that the global food security depends not only on raising global food production, but on reducing distortions in the structure of world food markets on shifting the focus of food production to food deficit countries, regions, and households. This shift in agriculture

production will be sustainable only if the resource base is sustained , enhanced and where it has been destroyed or diminished, restored.

The Asilomar declaration for sustainable agriculture (Jan, 1990) says that; sustainable agriculture alternatives are not only more efficient in their use of energy , biological sources of fertility and pest management, but also they enhance rural communities and encourage families to remain on the land . We commit ourselves to the harvesting broad adoption of an agriculture that is ecologically sound , economically viable and humane (Anon, 1993).

A major requirement for sustainability is the minimisation of external inputs required for production . Whatever the contribution from the external resources, the essential foundation of agricultural sustainability everywhere is the protection , maintenance and enhancement of the natural resource base, the soil , water , and vegetation that constitute the internal resources of every farming system.

Baum and Tolbart (1985) have summarised the lessons learnt from the World Bank investment on development as "With careful environmental management , the pace of economic and social progress need not be slowed in environmental work , the "Ounce of prevention" is almost always more important and less costly than the " Pound of cure"

Good management of information and inputs are very crucial for both economic viability and ecological soundness of farming . Intensive mono-culture has made production systems more susceptible to environmental stresses and shocks which is evident from diminishing returns . Intensive mono-cropping with genotypically similar varieties has also lead to increasing incidence of pest, disease and weed problem , some times aggravated by chemicals . Although the agricultural resources and the technology needed to

feed growing population are available, global food security requires increasing food production to keep pace with demand while retaining the essential ecological integrity production system (WCED , 1987). What is needed is a new approach , equally revolutionary but different in its ideas and styles. The new idea is sustainable agriculture which embodies ecological safetyness, economical security and social stability that provides food to millions of people on a continued basis . The strength of sustainable farming lies in its regional orientation and farms level input self sufficiency and output efficiency.That means sustainable farming offers a reliable way to make a living and a responsible way to produce good food (Delind , 1994).

Food means rice in Asia (Hargrove, 1990). In fact this domesticated grass provides more than half the daily food for one of every three persons living on earth today (White, 1994). The world produced about 526 m.t. of rice in 1992 and it is the single largest food grain consumed in the world. India produced about 101 m.t. in same year, thus contributing about 1/5 to the world rice basket (FAO, 1993). By 2000 AD, the global demand for rice would be around 585 m.t. The darker side of this supply-demand situation is the stagnant area; production and productivity levels of rice. Area under rice in India has remained stagnant around 14.3 m.ha. with the total production being stagnant around 271 m.t. (1994). Karnataka's share in this is about 1.37 m.ha with the total production being stagnant around 4.77 m.t. (Anon 1995).

Sugarcane occupies a pivotal position in the agricultural economy of India and world . Sugar is highly prized commodity and has became a symbol of affluence . Nearly 60% of centrifugal sugar comes from sugarcane and the rest from sugar beet; Sugarcane provides food, fodder and fertilizer and this world would be poorer without sugar and its

by-products. The sugar industry is a major employer providing gainful employment to millions of people world wide in farm sector, skilled and unskilled in the processing and refining of sugar. Natural sugar from cane is safe, nutritious, palatable and a cheap source of calories in countries facing food shortages, famines and starvation. Ergo, stated the slogan as, "eat sugar with pleasure but with a measure" (Hunsigi, 1994).

World's production of sugarcane is 635.3 m.t. and spread over in 11.9 m.ha. of area and its productivity stood around 53.4 t / ha. India stands first in sugar production since 1989 -90 to 1995 - 96 with a world record production of 267 lakh tons. of sugarcane and 165 lakh tons. of sugar. Karnataka stands fourth place in sugar production . In the year 1995 - 96,sugarcane production of state was 33 lakh tons. Sugar production of state is 12.72 lakh tons, and stands first in sugarcane productivity (104.5 t / ha).

In the year 1993 - 94, area under sugarcane in India was 3.5 m . ha. and production was 233 m.t. The sugarcane production which has shown an increasing trend during the last four decades is required to reach the level of 350 m.t. to meet the requirement of 220 m.t. of sugar for the country by 2000 A.D . (Jagadish lal, 1995).

The points narrated above clearly indicate that, though the area under rice and sugarcane crops remained stagnant ,the productivity of the same has increased considerably Even though agriculture production has remained stagnant, our farmers are getting more yield, at the cost of natural resources . Further more , higher utilization of external inputs viz., chemicals, fertilizers and energy inputs lead to deterioration of production environments, economical imbalance and social injustice in the society. This is more so in command areas where exploitation of natural resources is more due to irrigation facilities than other cultivated areas.

In Bhadra command area, rice and sugarcane are extensively grown by the farmers, by over exploiting natural resources. Farmers are getting higher yield at the cost of future

generation by affecting production environment. The development agency started educating the farmers about the practices which are sustainable. But farmers are not practicing same to the full extent. Hence, it is necessary to study to what extent the farmers have adopted the practices which are sustainable . And also it is imperative to examine and analyse the factors influencing and hindering the sustainability level along with constraints involved sustainability of rice and sugarcane farming system.

Keeping the above aspects in view, this study has been conducted with the following specific objectives.

Specific objectivies :

1. *To find out sustainability level of rice and sugarcane farming system.*
2. *To assess and compare the performance of indicators of sustainability of rice and sugarcane farming system.*
3. *To find out relationship between independent variables and their contribution on the indicators of sustainability of rice and sugarcane farming system.*
4. *To find out reasons for low sustainability in rice and sugarcane farming systems.*

Scope of the study:

This novel investigation helps to find the sustainability of both rice and sugarcane farming system . Further we can assess which farming system is more sustainable. The study would be of great help in assessing the factors influencing the sustainability of rice and sugarcane farming system.

It is hoped that the study would throw light on strong and weak points on components of sustainability of both rice and sugarcane farming system. In the process the reasons for low sustainability could be analysed and necessary measures to be suggested to overcome those lacunae.

Limitations of the study :

Basically, the study was handicapped to the extent that it was a single student venture. And , the associated constraints like time, fund, physical facilities remained. Inspite of this , the researcher has made worthwhile effort to select ideal locations for both the farming systems so that results of the study could be easily made applicable to similar situations elsewhere.

Operational definitions of concepts used in the study:

Sustainability of Rice farming system: Process by which the farmer manages soil and water relying mainly on farm resources to enhance the productivity and maintain to meet farm and family needs without affecting the production environment.

Sustainability of Sugarcane farming system: Process by which a farmer manages soil and water on his farm relying on farm resources (ie., the use of no cash and low cost inputs technologies, and minimising the use of chemicals) to maintain or enhance the productivity without affecting the production environment.

Presentation of the study :

The study is presented in six Chapters. The introduction , objectives and limitations of the study are presented in the first chapter. The relevant review of literature is presented in the Second Chapter. The Third chapter on methodology includes the study area, selection of variables, development of schedule and analysis procedure . This is followed by the presentation of the results of the study in chapter four, followed by discussion, summary and conclusions, references and appendices in subsequent chapters.

Review Of Literature

II REVIEW OF LITERATURE

The prime focus of this chapter is to report the theoretical views and empirical findings of the past and present theoreticians investigation and proponents concerning the present endeavour. As the roposed subject is new in its subject treatment, the previous studies on this aspect are scarce. The task was made much more difficult among the views resulting in contradiction and inconclusiveness.

The penurious availability of the reviews on sustainability of farming system has prompted the researcher to look for closely related reportings. The available literature has been presented under the following heads. In addition, conceptual frame work is also furnished.

2.1 The concept of sustainability and sustainable agriculture.

2.2 Dimensions and Components of sustainability.

2.3 Factors influencing sustainability and its components .

2.4 Problems related to sustainable agriculture.

2.1 The Concept of sustainability and sustainable agriculture.

Any agriculture system that can overcome a stress, defined as a discontinuity in the situation to which it is subject can be referred to as sustainable system . (Conway, 1985)

Altieri (1987) defined sustainability as the ability of an agro-ecosystem to maintain production through time in the face of long term ecological constraints and socioeconomic pressures.

World Commission on Envir nment and Development (WCED, 1987) defined sustainable development as the "development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs".

Tisdell (1988) referred sustainability to the ' propensity of the system to withstand collapse under stress'. It has to do with robustness or continuing viability of a system or low vulnerability. He points out that some systems may be highly productive, but subject to substantial risk as far as their sustainability is concerned.

Ainsworth (1989), the Editor of 'Farm Journal' has said "sustainable agriculture is profitable agriculture - short and sweet".

The term 'Lower input agriculture' and 'Low-Input sustainable Agriculture' (LISA) were coined in the 1980s by Clive Edwards and Dennis Oldustadt, respectively, (Madden, 1989).

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

Pioneers of 'Sustainable agriculture' were Franklin King, Lord Northbourne and Lady Eve Balfour.

In 1911, King published "Farmers of Forty Centuries: Permanent agriculture in China, Korea and Japan". The book documents how farmers in parts of East Asia

worked in fields for 4000 years without depleting the fertility of their soil (Reagonold et. al., 1990).

The terms 'Organic farming' was first used by Lord Northbourne and the phrase 'Sustainable agriculture' was coined by Lady Eve Balfour (Francis and Youngberg , 1990)

Singh et. al., (1990) defined sustainable agriculture as the one which makes use of low cost inputs , less amounts of chemical fertilizers, maintain soil tertility and ecological harmony. Further, these should maintain or increase the biological productivity.

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

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

Conway, et. al., (1991) opined that sustainability implies less specialized farming, often requiring mixed crop/livestock farming for less dependence upon outside inputs.

Sustainable agriculture can be defined as "the management and conservation of the 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 substainable development is environmentally non-degrading, technically appropriate, economically viable and socially acceptable (FAO, 1991).

Hess (1991) opined that 'low-input' is not an exactly appropriate term because it carries the wrong connotation, that something can be achieved for nothing. The preferred designation is 'Sustainable Agriculture'. This means the use of the very best technology in a balanced, well managed and environmentally responsible system. It relies on skilled management, scientific know-how and on farm activities.

NGO sustainable Agriculture treaty (Anon, 1993) lays the following principles for sustainalble agriculture.

* Agriculture is sustainable when it is ecologically sound, economically viable, socially and culturally appropriate.
* Sustainable agriculture preserves bio-diversity conserves and improves the chemical, physical and biological qualities of the soil.
* Sustainable agriculture uses locally available resources, minimises the use of external and purchased inputs thereby increasing local independence and self sufficiency.

Chopra (1993) identified sustainability as the desired ideal of achieving growth while maintaining natural capital intact.

For developing countries, sustainability is maintaining food production or increase that trend while reserving or enhancing the underlying resource base and minimizing wherever possible, of the dependence of production on external inputs (Jones, 1993).

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)

Krishna (1995) stated that sustainable agriculture as one which causes to prevent degradation of natural resources, besides satisfying the changing human needs. And sustainable agriculture requires to low inputs farming without damaging the resource base (land, water, forestry etc.)

Nataraju and Venkataranga Naika (1995) stated that the close nexus between agriculture and environment calls for promoting sustainable agriculture which should lead to increased farm productivity , while ensuring the future security and less risks to the environment . Sustainable Agriculture(SA) is invariably linked with integrated rural development and requires a multidesciplinary approach, which calls for close liason between farmer and research-system.

Chandre gowada (1996) defined the Sustainability of Rice farming as the process by which the farmers manages soil and water relying mainly on onfarm resources to enhance the productivity and maintain it to meet farm and family needs without affecting the production environment.

The foregoing definitions of sustainability & sustainable agriculture concur with the multidimensional nature of the concept. Commonly found considerations are ecological safety, economic viability, social stability and humanness.

Farming can cause ecological damage or improve it through abuse or judicious use of soil and water. To be economically viable, it should give secured returns,

enhanced yield per unit area and per unit of investment. To be socially just and humane, farming should offer sufficient food to the depending members of the family, should be done within the naturalistic and non-naturalistic inputs possessed by the farm family. While doing so, the production environment as to be safeguarded which implies to protect the air, natural predators and composes of soil organic matter, which is achieved through judicious use of pesticides and chemicals.

On this very foundation, the present operational definition of " Sustainability of Rice farming" and "Sustainability of Sugarcane" farming has been arrived.

2.2 Dimensions and Indicators of sustainability:

Douglas (1984) opined that sustainability of soils, food self sufficiency and profitability on stable basis as the three primary dimensions of sustainability.

Edwards (1987) identified sustainability of soils, food self sufficiency and profitability on stable basis as the three primary dimensions of sustainability.

Ehrenfeld (1987) expressed that sustainable agriculture should resist anything that tends to separate farmers from their lands. Keenay (1989) felt that environmental soundness, profitability, productivity and maintenance of social fabric or rural community as the primary concern of sustainable agriculture.

The International Federation of Agricultural Producers (IFAP) seminar for developing Farm Leaders concluded that the three interlined aspects of sustainable agriculture are sound environmental management, conservation of natural resource base and attainment and continued satisfaction of human needs (Anon, 1990) .Further , the seminar identified the following the characteristics of sustainable agriculture system.

i) Stability - no built up of pests

ii) Regeneration capacity - nutrient replenishment

iii) Productivity and profitability - surplus farm produce

iv) Resiliency - Resistance to external threats

v) Appropriateness - to the needs and skills

vi) Self- reliancy - for inputs

vii) Non- distruptiveness of social setting

Bunch (1990) remarked that sustainable agriculture is characterised by greater reliance on information and lesser reliance on chemical and energy inputs.

Francis (1990) opined that sustainable agriculture is represented by organic farming to maximum economic yields.

Francis and Youngberg (1990) were of the view that sustainable agriculture systems are indicated by reduced ecological degradation, stable agriculture productivity, economic viability, stable rural communities and quality of life.

The workshop comprising farming professionals and organised by ILEIA came out with five important criteria to assess any technology for its sustainability. They are productivity, security, identity, continuity and adaptability (Anon . , 1991).

Conway et. al., (1991) believe that sustainability should necessarily exhibit less specialisation and less dependency on outside inputs.

Floquet (1991) reported that major criteria on which farmers based their decisions were food supply, cash income and input productivity.

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

Swaminathan (1991) proposed Sustainable Living Security (Livelihood options which are ecologically secure, economically efficient and socially equitable) Index (SLSI) claimed to be the legitimate indicator of Sustainable Development of Agriculture (SDA) because of its intimate linkage with welfare goals like poverty alleviation, meeting basic needs, human development and quality of life.

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.

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

Agro-ecologically, system resilience, efficiency of inputs and recycling of nutrients were considered as important indicators. Equity interpretation focuses on inter-generation equity and the rights of non-human species. The third and major interpretation is sustainable growth which focuses on continued growth in agricultural productivity, while maintaining the quality of resources devoted to agriculture.

Reijntjes et. al., (1992) remarked that agriculture is sustainable, if it is ecologically sound, economically viable, socially just, humane and adaptable. Further, they opined that objectives of any household are productivity (output per unit of land

and input used), security (minimising risk of production), continuity (maintaining soil and water health) and identity (self respect, social justiceness and humanness). 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.

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.

Jones (1993) opined that any concept of agricultural sustainability must accommodate the dynamic interaction, positive and negative, between agricultural activities, environment and society.

The narrow focus of the production function on the inputs of land, labour, capital and management and the use of farm profitability as the primary definition of sustainability have come under severe attack from sustainable agriculturists, who argue that the social and environmental consequences of production are as important as the economic outcomes (Lyson and Welsh, 1993).

Nadakarni (1993) observed that the ecologists like Gordon Canway have developed operational or observable indicators of sustainable development . The indicators are:

i) Productivity (yield or net income)

ii) Stability of yield or net income

iii) sustainability of yield and net income and

iv) equability in terms of income distribution.

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.

Saleth (1993) agrees with the critical dimensions of sustainable development in general and sustainable development of agriculture (SDA) in particular viz., ecology, economics and intra, inter-generational equity quoted by Barbier (1989), Daly (1990) and Swaminathan (1991).

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.

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

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

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.

The above mentioned reviews bring out a variety of indicators/ components/ dimensions of sustainability at different level thus emphasising the fact that sustainability and sustainability farming are indeed multidimensional concepts. Situational differences apart, all the reviews have given prominence to ecological, economic and social dimensions, although, within these dimensions, the components and indicators included have variegation. These studies served as foundation for the initial identification of the indicators which was the starting point of this research study itself.

2.5 Factors influencing sustainability and its dimensions/ components :

Fitzsimmons and Manning (1961) reported that financial security was inversely related to family size and positively related to ability to attain goals.

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

Hendee,et.al., (1969) opined that education is strongly associated with environmental concern .Same was reported by Buttel and Flinn (1947) also.

National Wildlife Foundation (1969) observed that age and environmental concern were inversely related.

Significant and positive relationship between economic motivation was reported by Singh and Singh (1970) and Veeraswamy & Bahadur (1979).

Himantharaju (1983) have reported that age and adoption of selected portion of summer paddy cultivation was not associated with each other .

Himantharaju (1984) observed that farmers with some education adopted more number of practices.

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

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

Bora and Ray (1986) revealed that returns to the farmers management was significantly corrected with farm size, cropping intensity, innovation proneness, farming experience, economic motivation and level of aspiration.

Dwarakanath (1987) reported that there was no significant relationship between economic status and adaptation among paddy and cabbage farmer with respect to the adoption of intermediate technologies. Further, he reported that a positive and significant association between extension contact and adoption.

Gogoi & Gogoi (1989) reported that, the variable age was found to have negative and significant contribution. Massmedia exposure size of operational land holding, knowledge level, and extension contact had positive and significant contribution on adoption of plant protection behaviour of rice farmers .

Lancini (1987) found that increased contact with the researchers and extension technicians has given the farmers a more distinct role in the development of strategies they consider necessary to improve the household.

Malia and Korsching (1989) reported that there was no evidence of differences between conventional and organic operations with respect to size, tenure, age or education level of the producer.

Nagaraja (1989) reported that sericulturist's management efficiency significantly influenced their economic performance. He also revealed that management efficiency and economic performance were significantly influenced by land holding, rearing intensity, education, experience, economic motivation, level of aspiration, innovation proneness, self reliance, scientific orientation, achievement motivation and contact with extension agency.

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 revealed that women involvement in farm decision making had no influence on farm productivity.

Gowda (1991) revealed a positive and significant relationship between crisis management of farms and their prior exposure to crisis, farming intensity, farm size, attitude towards farming system and achievement motivation.

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.

Beus and Dunlop (1994) reported that attitude towards sustainable farming do predict the behavior but only when the level of correspondence between them is high.

Patel,et.al., (1994) concluded that education, land holding extension participation and cosmopoliteness influenced the knowledge of sugarcane growers and education, annual income, land holding, extension participation, cosmopolitenes and knowledge of the sugarcane influenced their adoption behavior.

Saltiel,et.al., (1994) revealed a strong influence of diversified crop-livestock operations, considerations to future plan, perceived long range profitability, favourable attitude towards alternative agriculture and access to information from professionals and farm trade journals on adoption of low input sustainable agriculture (LISA) practices.

Bhatkar,et.al., (1995) reported Management orientation, and agriculture progressiveness , occupation, sugarcane cultivation experience & socio-economic status, were positively and significantly correlated with amount of knowledge possessed by the sugarcane growers. But, where as Age, Education, Annual Income, Landholding, Social Participation, Economic motivation, sources of information, infrastructure were found to be non significant correlation with amount of knowledge.

Gangadharappa,et.al., (1995) revealed that all the 28 factors viz., sociological, economic ,situational, psychological and cultural factors are positively related with adoption behaviour of the farmer at varied degrees.

Pandey (1995) revealed that the changing scenario of agricultural demands thorough investigation into farmers system in an open and participative manner. Farmers must participate in deciding problems and conducting and collaborating in actual research . Such radical shifts demand communication links between various partners of agricultural research and technology transfer.

Perumal, et.al., (1995) suggested that, for strengthening the farm extension should emphasize the various measures of availing the existing resources to effect sustainable farm income and also sustainable human development, including the gloabalisation of markets on capital, goods, services and other international standards in coming years.

Verma (1995) indicated that majority of farmers preferred progressive farmers as most important source of information for all aspects of sugarcane cultivation . The next in order of preference was observed demonstration by all categories of farmers except marginal farmers.

Wasnik, et.al. , (1995) stated that socio - economic status had significant association with adoption of sugarcane practices. Where as non-significant association was observed with respect of age, education, caste, landholding and family size.

Yadav and Verma (1995) indicated that various liberalism, outside urban contacts, training exposure and training situation are crucial variables in order to develop human resource of rural women to attain the goal of sustainable agriculture.

Chandre gowda (1996) concluded that rice farming is only moderately sustainable. Attitude towards sustainable farming, farming commitment, economic motivation, linkage with extension system, innovativeness and paddy farming intensity had significant contribution for the variation in sustainability of rice farming. Attitude towards sustainable farming and farming commitments were strongest in influencing and economic motivation and paddy farming intensity were found to be negatively influencing in irrigated rice eco-system and tank fed system.

It is evident from the reviews cited above that personal, situational psychological and communication factors possess either positive or negative influence on sustainability of farming or its dimensions and components. Hence, it was decided to study the influence of these variables on sustainability of rice and sugarcane farming.

2 . 4 Problems related to sustainable agriculture.

Joshi (1987) reported that more than half of the small farmers, growing sugarcane in Gujarath State could not adopt improved cultivation practices due to lack of irrigation facilities, costly inputs, irregular and insufficient power supply.

Jaiswal and Sharma (1990) revealed that non availability of seed at proper time, lack of knowledge regarding correct dose of seed, unaware regarding method of seed treatment , lack of irrigation, not maintaining proper plant spacing , non - availability of organic manure, high cost of fertilizer, non availability of labour at the time of weeding, lack of knowledge and technical guidance regarding proper use of plant protection measure were the first and foremost constraint in the production process, and poor economic condition of farmers also does not permit to adopt this technology.

Swaminathan (1990) stated that,

(1) crop rotation that mitigate weed, disease and other pest problem, increase available nitrogen and reduce the need for purchased fertilizer and in conjunction with conservation tillage practices, reduce soil erosion.

(2) Integrated pest management that reduce the need for pesticides by crop rotation , weather monitoring, scouting, use of resistant cultivars, timing of planting and biological pest control.

(3) Management systems to control weed and improve plant health.

(4) Soil and water conserving tillage.

(5) Animal production system with stress on disease prevention.

Venkata ramani (1991) concluded that we are using IVM & IPM but there has been no concerted effort to develop a sound package of environmental safe farming practices that could be tested and adopted extensively by the farmers . The absence of such an organised support from the agricultural scientists and the technology has left the farmers with no other options, but to continue with the known technique which brings problems. The agricultural persons though aware of the ill effects of modern agricultural systems, remain helpless without an effective alternative systems.

Perumal, et.al., (1992) concluded that the major components of the new 'integrated extension model' namely integrated land use approach resorting to a combination of profitable , compatible and sustainable agriculture and allied enterprises, training the extension functionaries for whole role performance , replacing the contact farmers approach, satellite farm concept, block level planning to ensure more participation of farmers etc. along with the structural and functional changes recommended can be adopted in the place of the existing T & V system in different states of the country with certain modification that are essential with reference to a given situation.

Differential pricing policy, poor productivity in northern states, lack of technical know-how, high price of inputs, lack of irrigation facilities and an non-availability of

labour are the important factors responsible for low production and productivity in India (Anadurai et. al., 1994)

Mahalingam (1994) identified four major constraints faced by sugarcane growers in India. They are, lack of technical know-how, lack of timely and adequate credit, unmodernized sugarcane factories and payment from sugar factories.

Paul mansing and Nelaj Seth raman (1994) concluded that reinvention accured in fertilizer usage and also farmers discontinued the practice of treating the sets with Azospirillum. Soil type and labour problem were one main reason for reinvention and discontinuance respectively .

The major constraints in the transfer of sugar cane technology to the farmers of western Utter pradesh were non-availability and high cost of inputs, adulterated inputs, lack of finance, and training opportunities. (Singh and Laharia, 1992)

Shinde,et.al., (1994) noticed that a overwhelming majority of the respondents changed the recommended practice of inter cropping and modified the doses of fertilizers and method of planting cane sets.

Anonymous , (1995) stated the major problem of obtaining sustainable production are:

(1) Soil erosion ,

(2) Over use of chemicals,

(3) Water logging and salination results from over use of water,

(4) Over use of ground water.

Anil Gupta and Sujat Kamal (1995) revealed that the agriculture pricing policy which was an important instrument in bringing about self sufficiency in food production, may have encouraged degradation of natural resources. Input subsidies,

which are provided to improve the use of inputs like fertilizers, water etc., have encouraged the inefficient use of these inputs and other resources, production prices have degraded resources and income support programs have restricted crop rotation.

Geetha, (1995) found that 69 per cent of shareholders and cent per cent of Non- share holders faced problem in 'delay of accepting cane' by the co-operative sugar factories of Belgaum district.

Jayanthi,et.al., (1995) stated that integration of cropping , mushroom production, fish culture and poultry in line with farm size and resources availability could be resorted for income and environmental stability.

Ganjir (1995) concluded that, the FYM with urea super granules significantly increase the grain and TDM yield of rice crop , the application of 5 tones of FYM with urea super granules was found best treatment combination for rice crop in vertisol.

Kaushik,et.al., (1995) concluded that in our daily diet of 2200 calories, 0.5 mg. of DDT and HCH are injected . It is 40 times more than the developed countries. More over indiscriminate use of insecticides create resistance and , resurgence in insect pests and epidemics are resulted and ultimately causing low productivity of crops. Therefore judicious use of insecticides incorporated integrated pests management is the answer in stabilising the crop production.

Malik and Punia (1995) indicated that land , water, biological diversity and energy and ecological foundation essential for sustainable advances in crop and in animal productivity which have to be kept in mind for sustainable development phenomenon.

Mahesh chander (1995) reported that, it is now internationally recognised in principle that high input agriculture is unsustainable , harmful to human, livestock and environmental health on the whole . Thus, efforts are on at every level to promote organic agriculture so, as to make agriculture more sustainable . The information has made tremendous advancement in areas of rapid information and creating awareness among people.

Raghavulu (1995) reported that, in recent times, realising the scarce and costly nature of ground water, some enterprising farmers are adopting sprinkler and drip methods of irrigation for commercial and orchard crops in order to achieve greater efficiency and economy in irrigation. Farmers participation and involvement is becoming important in the equitable and efficient distribution of water in a command area.

Rai and Mehta (1995) revealed that the solution of the controversy of agricultural development vis-a-vis ecology and environment lies in the judicious use and proper management of new technologies to keep its ill effects to the tolerance level. Side by side to keep future more safe and secure ,alround efforts need to be made to develop pollution free new technologies capable to meet increasing food demand.

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 enterprise.

Singh and Subodh (1995) reported that, there is a need to give much emphasis on extension activities to transfer bio-fertilizer technology through out the country and for this purpose a national network of integrated information on sustainable agriculture is to be needed to co-ordinate and disseminate through out the country.

Sivanantham and Subramaniam (1995) reported that, In India, small and marginal farmers are predominant. They operate only at low level of output and productivity. This is due to rapid increase in input prices and relatively statutory prices of output. High prices of inputs lead to operational inefficiency. Hence, the achievement of sustainable growth of agriculture lies in the use of low cost inputs such as bio-fertilizers which not only improve the soil health but also reduce the cost of inputs and therfore it has to be promoted for large scale adoption.

Yashpal, et.al., (1995) revealed that the exhaustive nature of rice, wheat cropping system has also resulted in degradation of land, water logging problems, increase in salinity and other health hazards. This calls for balanced, integrated approach for the use of resources and cultivation system from monoculture to diversification of crop rotation.

Karthikeyan, et.al., (1996) reported that, more than half of the registered sugarcane growers of Pandicherry Co-operative sugar mill faced the problem of high cost of inputs and also the problem of pests and diseases to their crops.

Gangadharappa (1996) indicated that any participation approach to be effective for technology assessment and refinement must consider the following dimensions.

(1) Assessment of physical and socio-economic environment of farmers.

(2) Understanding of the farmers in terms of their skills , constraints, preference and aspirations.

(3) Evaluate the existing technologies along with the farmers.

(4) Conduct research on problems identified by farmers.

(5) Validate the research with farmers on farms.

(6) Integrate the research with the people , extension personnel etc., by conducting education activities.

(7) Use of suitable media to diffuse and to make the farmers to accept the tested technologies.

2.5 Conceptual frame work :

Conceptual frame represents the researcher's understanding of a particular set of circumstances and of the simplifications which he feels may be made inherently complex relationship. Researcher's intention supported by past works formed the basis for conceptual framework developed for the study. The variables included in the study were classified under dependent and independent variables.

Independent variables are conceived as those which precede the others in the order of time and which theoretically expected to lead or to be followed by certain other variables. In the present study personal, psychological, situational and communication factors of rice and sugar cane growers were considered as independent variables. The dependent variable is the one that is being predicted from independent variables. Sustainability of Rice farming system and sustainability of sugar cane farming were the dependent variables in the present study.

Methodology

III METHODOLOGY

In this chapter, a general description methods and procedures adopted in the present investigation are presented under following subheads:-

3.1 Population

The population is the farmers in major rice and sugarcane growing tracts of Karnataka .

3.2 Selection of district

Considering the highest area under rice and sugarcane crop, the Shimoga district which is possessing higher rice farming intensity and sugarcane farm intensity was purposefully selected.

3.3 Selection of taluks

The taluks coming under Shimoga district were arranged in a descending order considering the area under the rice and sugarcane crop. Bhadravathi stands first according to said criteria and this was selected purposively for the study.

3.4 Selection of villages

From Bhadravathi taluk, a five villagers each having larger area under rice and sugarcane during 1995 - 96 was prepared by obtaining the information from the Assistant Director of Agriculture of the taluk.

The villagers selected are presented below :-

Rice farming system	Sugarcane farming system
1. Jedikatte	1. Arlikatte
2. Bommenahalli	2. Siriyuru
3. Veerapur	3. Karehalli
4. Baranduru	4. Kadada katte
5. Marishettahalli	5. Hallikere

3.5 Selection of respondents

From these villagers a list of farmers who were cultivated rice and sugarcane during 1995 -96, Rabi / Summer was prepared . From among the listed farmers in each system, ten farmers were selected by using purposive stratified random sampling and thus fifty farmers each in rice and sugarcane farming system constituted the sample for the study.

3.6 Selection of components of sustainability of rice and sugarcane farming system.

The components which were contributing to the rice farming system identified by Chandre gowda (1996) were considered for this study. The components of sustainability of sugarcane farming system were identified with the help of experts . A list of sustainable farming practices in sugarcane was prepared by consulting the literature and subject matter specialists. The list was presented to 25 sugarcane specialists for their opinion . The components accepted by these experts were taken into consideration to identify indicators of sustainability of sugarcane farming system (Appendix - I).

3.7 Research design

The present investigation deals with a phenomenon which has already occured or could not be manipulated. In view of the prevailing situation, sample size and the phenomenon studied, the expost facto design was selected as an appropriate research design . This design can be used to devise studies, to deduce theories, identify behaviour phenomenon and explore conditions under which phenomenon occurs (Rabinson, 1976).

3. 8 Methods used for quantifying the independent and dependent variables

The sustainability of rice farming and sugarcane farming were considered as dependent variables in the present investigation . Thirteen variables classified under personal, psychological, situational and communication factors were considered as

independent variables to study their relationship and influence on the dependent variable . The classification was done on the researcher's perception as well as review of the past work.

The list of variables and measurement tools used have been given below.

Variable	Measurement tool used
1. Dependent variables	
A. Sustainability of rice farming	Index developed by Chandregowda(1996)
B. Sustainability of sugarcane farming	Schedule developed for the study.
Components of sustainability index	
1. Nutrient management	Index developed by Chandregowda(1996)
2. Water management	Index developed by Chandregowda(1996)
3. Integrated pest management	Index devloped by Chandregowda(1996)
4. Land productivity	Formula available
5. Input productivity	Formula available
6. Crop yield security	Formula available
7. Information self reliancy	Scale developed by Chandre gowda (1996)
8. Input self sufficiency	Sale developed by Chandre gowda (1996)
9. Ratoon management	Schedule developed for the study

II	Independent variables	Measurement tool used
	Age	Schedule developed for the study
	Rice / Sugarcane farming experience	Schedule developed for the study
	Family education	Schedule developed for the study
	Family size	Schedule developed for the study
	Farm size	Schudule developed for the study
	Rice/Sugarcane farming intensity	Schudule developed for the study
	Achievement motivation	Scale developed by Prasad (1983)
	Attitude towards sustainable farming	Scale developed by Bues & Dunlop (1991)
	Economic motivation	Scale developed by Supe (1969)
	Innovativeness	Scale developed by Feaster (1968)
	Value orientation	Scale developed by Alexander (1982)
	Extension system link	Scale developed by Gowda (1991)
	Research system link	Schedule developed for the study

3. 9. Methods used for quantifying the dependent and independent variables

3. 9.1. Components of dependent variables :

3.9.1.1. Sustainability level of rice and sugarcane farming system :

The overall sustainability level is divided into three categories considering the overall mean percentage values. They are as follows ,

Low level of sustainability	Below 50
Medium level of sustainability	Between 50- 75.
High level of sustainability	Above 75.

3.9.1.2 Nutrient Management [N M]

Nutrient management was operationalised as an application of right quantity of organic and inorganic fertilizer and amendments to soil at a proper time, method and combination aimed at deriving maximum benefits and causing minimum damage to resource base.

For rice farming system, the NMI (Nutrient Management Index) developed by Chandre gowda (1996) was used. Keeping the operational definition in mind, a list of questions related to nutrient management was prepared for Sugarcane farming . Maximum care was taken to cover all the aspects of nutrient management in sugarcane. The list was then subjected to correction by experts. Final list was used to collect the data and scoring was done by using the procedure given by Chandregowda (1996)

Minimum possible score was '0' and maximum possible score was 30 in rice farming and '0' and '32' in sugarcane farming . In the present investigation the scores ranged from 14 to 27 for rice and 17 to 30 for sugarcane farming system.

Nutrient Management Index (NMI) for an individual farmer was worked out by using the formula .

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

3.9.1.3 Water Management [W M]

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 [Gupta and Gupta, 1992].

The important aspects of water management at pre, post-fertilizer application, water management at critical stages of crop growth, water management at scarce, flood situations, and managing problematic soils were considered while developing the list of questions. The list was discussed with agronomists before finalisation. The scoring pattern was used as given by Chandre gowda (1996) for both rice and sugarcane farming system with little modification.

Minimum and maximum possible scores were '0' and '30' in rice farming and '0' and '18' in sugarcane farming system. In the present investigation, scores ranged from 18 to 27 in rice and 13 to 17 in sugarcane farming systems.

Water Management Index (WMI) was worked out by using the formula

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

3. 9.1.4 Integrated Pest Management [IPM]

Integrated pest management was 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. [Chandre gowda, 1996]

The Index developed by chandregowda , (1996); was directly used to measure integrated pest management in rice and sugarcane farming system.

Minimum and maximum possible scores on the scale were '0' and '30' for both the farming system. In the present investigation, respondents scores were ranged from 11 to 22 in rice and 9 to 18 in sugarcane framing system.

The Integrated Pest Management Index (IPMI) was worked out by using the formula;

$$IPMI = \frac{\text{Actual score}}{\text{Possible Score}} \times 100.$$

3.9.1.5 Crop Yield Security :[CYS]

Crop yield security was operationalised as the extent to which farmers manage rice /sugarcane crop so as to withstand the external crisis may be due to excess or shortage of rainfall, out break of pest , non-availability of inputs and inability of the farmer to take up timely operations and timely marketing of sugarcane crops, are included.

Crop Yield Security Index (CYSI) is expressed interms of the percentage yield obtained to that of the yield expected. Expected yield is taken as the summation of yields obtained and the loss in yield , if any due to only of the external factors cited above.

$$\text{CYRI} = \frac{\text{Yield obtained}}{\text{Expected yield}} \times 100.$$

The minimum and maximum possible scores were '0' and '100' . In the present investigation , CYSI values ranged from a minimum of 61 to a maximum of 94 for rice and 65 to 94 for sugarcane farming system.

3.9.1.6 Land Productivity. [L P]

Land Productivity was operationalised 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.

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

In the present investigation average land productivity values ranged from 4 tons/ha to 7.5 tons/ha in rice and 112.5 tons/ha to 200 tons/ ha in sugarcane farming system.To find out the sustainability level, the ratio of actual value to maximum value of land productivity of rice and sugarcane farming system into 100 were taken.

$$\text{Sustainability of land productivity in rice / sugarcane farming} = \frac{\text{Actual value}}{\text{Maximum value.}} \times 100$$

3.9.1.7 Information Self Reliancy [ISR]

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

To measure information self reliancy the scale developed by Chandre gowda 1996 was taken. The scale was little modified for sugarcane farming system. Information self reliancy was measured on a 3 point continuum of reliancy - dependency ranging from completely reliant, partially reliant and completely dependent, with a score of 2,1, and 0 respectively.The 23 information areas in rice and 26 information areas in sugarcane farming was included. The difficulty scale values given by Chandregowda (1996) was used .

Information Self - Reliant Index (ISRI) was obtained by using formula,

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

Theoretically, an ISRI value of 100 indicates a farmer who is completely self reliant for information and a value of '0' would indicate a farmer who is completely dependent on other for information. In the present investigation, the values ranged from a minimum of 66 to a maximum of 95 for rice and 65 to 93 for sugarcane farming system.

3.9.1.8 Input Productivity [I P].

Input Productivity (I P) was defined as output per unit of input used. It was expressed as the ratio of gross output to the total variable cost.

$$IP = \frac{\text{Total value of the output}}{\text{Total variable cost.}}$$

In the present study, input productivity values ranged from a minimum of 0.7 to maximum of 3.7 in rice and 1.7 to 4.5 in sugarcane farming system.

To find out sustainability level in both rice and sugarcane farming system IP is converted into percentage by using ratio actual value of IP to maximum value of IP into 100.

$$\text{Sustainbility level of IP in both the farming system} = \frac{\text{Actual value of IP}}{\text{Maximum value of IP .}} \times 100$$

3.9.1.9 Input Self Sufficiency [I S S]

Input Self Sufficiency was operationalised as the extent to which farmer was able to meet the input requirement of rice or sugarcane from own resources than the purchased inputs. It was taken as the ratio of values of owned inputs to the total value of inputs used in rice/sugarcane farming. Value of inputs was worked out at the prevailing rates in that area at the time of data collected.

The Input Self Sufficiency Index (ISSI) was calculated by using the formula.

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

Theoretically, an ISSI value of '0' indicates that the farmer was completely dependent of external inputs and a value of '100' would indicates a farmer who was completely dependent on owned inputs.

In the present investigation, ISSI values ranged from 15 to 66 in rice and 18 to 66 in sugarcane farming system.

3.9.1.10 Family Food Sufficiency [FFS].

It was operationalised as the extent to which the farm family possessed sufficient rice required for family consumption. It was measured in terms of ratio of the quantity of rice available for consumption to that of quantity required for the entire year.

Surplus rice of previous year, if any was added to current years available quantity for calculation purpose. The data was collected for three years and the average was taken. FFS ratio were calculated by using the following formula.

$$\text{FFS} = \frac{\text{Quantity of rice available for consumption}}{\text{Quantity of rice requirement for consumption for year.}}$$

A FFS value of less than one indicates food insufficiency and ratio of more than one indicates the surplus. In the present investigation, the FFS ratio's were ranging from 1.0 to 6.2.

To find out sustainability level, FFS value is converted into percentage by using the ratio of actual value of FFS to maximum value of FFS into 100.

$$\text{Sustainablity level of FFS in rice and sugarcane farming} = \frac{\text{Actual value}}{\text{Maximum value.}} \times 100$$

3.9.11 Ratoon Management in Sugarcane Farming :

Ratoon cropping was defined as the cultivation of the crop growth after cane harvest, although not necessarily for grain [Francis 1989]. It includes stubble shaving, and shoulder breaking, gap filling, trash management, along with other practices involved as in main crop.

For this study it is operationalised as the cultivation of sugarcane crop by following all the recommended packages after the cane harvest. The list of package of practices used in ratoon management was prepared in consultation with Agronomy specialists. The finalised list was given to these experts to decide scoring pattern. The average score were combined with researchers scoring and arithmetic mean was taken to arrive at the final scoring.

Maximum and minimum possible scores on the scales were '8' and '0' . In the present investigation, respondents scores were ranged from 5 to 8.

3.9.2 Measurement of Independent variables :

3.9.2.1 : Age

Age of the farmer was recorded as number of completed years. The score interms of number of years was directly used in analysis and interpretation.

3.9.2.2 Rice / Sugarcane Farming Experience:

Rice farming experience was considered as the total number of years a farmer has cultivated Rice / Sugarcane either on his own farm or others farms. Actual score of number of years was directly used for further analysis.

3.9.2.3 Family Education :

Family education level was taken as the average schooling years of the family member who were above five years.

3.9.2.4 Family Size :

Family size was taken as the total number of family members irrespective of age.

3.9.2.5 Farm Size :

Farm size was taken as the total number of standard acres a farmer owned at the time of data collection including the land leased in.

3.9.2.6 Rice / Sugarcane Farming Intensity :

Rice / Sugarcane farming intensity operationalised as the extent of cultivated area being utilized for rice/sugarcane cultivation. Rice or Sugarcane farming intensity was measured as the ratio of the area under rice or sugarcane to that of grass cultivated area expressed in percentage.

$$RFI = \frac{\text{Area under rice / sugarcane}}{\text{Gross cropped area.}} \times 100$$

By definition, rice / sugarcane farming intensity of a farmer ranged from 0 to 100.

3.9.2.7 Achievement Motivation :

Achievement Motivation was operationalised as a value associated with a farmer which drives him to excel in farming and there by attain a sense of personal accomplishment.

Achievement motivation was measured by the scale developed by Prasad (1983). This scale was used because it was developed specifically to measure the achievement

motivation of rice growers in southern states of India. And the same scale was used for sugarcane farming system.

The scale with 10 statements and the sub-statements to each of the statement was used without any modifications. A score of one was given for response indicating achievement motive and zero for otherwise. Thus, the possible range was 0 to 30.

3.9.2.8 **Attitude Towards Sustainable Farming** :

Attitude is a relatively enduring organisation of an individual's belief about an object that predisposes his actions (Rogers and Shoemaker, 1971).The present study has made use of the scale developed by Beus and Dunlop (1991) which was modified by Chandregowda (1996) was used. The final scale with 20 statement has ten positive and ten negative statements. There have been randomly listed in the final format. The responses were obtained on a five point continuum of agreement ranging from 'strongly agree' to 'strongly disagree' . A score of 5,4,3,2 and 1 for positive statements and the reverse for negative statements was given for respective responses on the continuum. In this way, minimum and maximum scores were 20 and 100, respectively.

3.9.2.9 **Economic Motivation** :

Economic Motivation defined as the extent to which an individual is oriented towards achievements of the maximum economic ends such as maximisation of profits.

Economic motivation scale developed by Supe (1969) and adopted by Prasad (1983) was followed . The responses were obtained on 'yes' and 'no' dichotomous categories for each statement. The first four statement in the scale were positive and the last four were negative. 'Yes' response on a positive statement and 'No' response on a

negative statement attracted one score each. Thus the minimum and maximum possible scores were 0 and 6, respectively.

3.9.2.10 Innovativeness :

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

The innovativeness scale developed by Feaster (1968) and modified by Prasad (1983) was used in this study. Eight statements with first four positive and next four negative constituted the scale . The responses were obtained on a three point continuum viz.., 'yes' ,'undecided', and 'no' with a scoring pattern of 2,1, and 0, respectively for positive statements and 0, 1, and 2 for negative statements. The summated score indicated the innovativeness of the farmer. By definition maximum and minimum possible score were 16 and 0 respectively.

3.9.2.11 Value orientation :

Values are the standards upon which evaluation are made; the criteria by which both ends and mean are chosen. Consequently an individual is emotionally committed to standards in such a way that they influence guide and direct his behaviour.

Scale developed by Alexander (1982) was utilised in this study to measure value orientation of the respondent farmers. The ten statements were measured on a dichotomous response category viz., 'agree' and 'disagree' . The value oriented statement received score of 1 and 0, respectively where as, the other statement received 0 and 1, respectively. Thus, the minimum and maximum possible score were 0 and 10, respectively.

3.9.2.12 Extension System Link:

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

The scoring procedure adopted is furnished below.

I Frequency of extension personal 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 a Extension Methods:

Participation	Weightage
Regular	2
Occasional	1
Never	0

The weightages scored on these two dimensions were summed up to obtain the total extension system link score of a respondent.

3.9.2.13 Research System Link :

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

The quantification of this variable was done by Chandre gowda (1996) used for the study . Activities included in the final format with respective weightages are given below.

	Activities	Weightage
1.	Correspondence with the scientists	1
2.	Scientist's visits to farmers field	1
3.	Farmers visit to the research station	2
4.	Participation in exhibition / work shops/ seminars / field days etc., organised at research station	2
5.	Taking up adoption trials and frontline demonstrations	4

Farmers were asked to give number at times they have established contact with the research system during the previous one year. Number of contacts or activities were multiplied with respective activity weightage and summed upto arrive at an individuals research systems link score.

3.10 Construction of Interview Schedule :

For rice crop, Schedule prepared by Chandregowda (1996) was considered and also suggestions given by experts were incorporated to suit the study situation. For sugarcane crop, draft of interview schedule was developed according to objectives and questions framed for each component / variable considered in the study.

The repleteness of the schedule was confirmed by circulating among the academicians and sugarcane specialists. The suggestions were duly incorporated to make the schedule complete in all respects. The schedule was pre-tested in a non-sample area and necessary corrections were made to arrive at a final format of the schedule (Appendix III).

3.11 Data Collection :

The data were collected with the help of the schedule by personal interview method in an informal atmosphere at the farm and at homes of the respondents.

Assurance was given to the respondents for keeping their data confidential with a view to eliciting unbiased and objective information.

3.12 Tools of Statistical Analysis :

The sample of the study in respect of each crop was subjected to different statistical tests based on the objectives of the investigation and the same are presented below.

- To find out the sustainability level in rice and sugarcane farming mean percentage values were used.
- To assess and compare the performance of indicators of sustainability of rice and sugarcane farming 't' test was used.
- To find out association between independent variable on the indicators of sustainability of rice and sugarcane farming, correlation co-efficients (r) were computed.
- To find out contribution of independent variable on the indicator of sustainability of rice and sugarcane farming systems,multiple regression analysis were computed.
- To find out problems in rice and sugarcane farming system simple percentages were used.

Results

IV. RESULTS

The results of the present investigation are presented in this chapter under the following heads.

4.1 Sustainability level of rice and sugarcane farming systems

4.2 Comparison of performance of indicators of sustainability

4.3 Relationship and contribution of independent variables on indicators of sustainability of rice and sugarcane farming system.

4.4 Reasons for low sustainability of rice and sugarcane farming systems

4.1 Sustainability level of rice and sugarcane farming systems :

A . Sustainability level of rice farming system:

The results given in the Table I, and fig 1 show that , of the nine components, two components viz., input productivity and input self sufficiency were found to have low level of sustainability . All the components of ecological dimension of sustainability viz., nutrient management, water management and integrated pest management and one components of social dimension had medium level of sustainability whereas two components of economical dimension of sustainability viz., crop yield security, land productivity and information self reliancy of social dimension had high level of sustainability in rice farming system.

However, overall sustainability level of rice farming stood at 66.26 which lies in the range between 50 to 75 mean percentage value and hence it is considered that sustainability in rice farming system was of medium type.

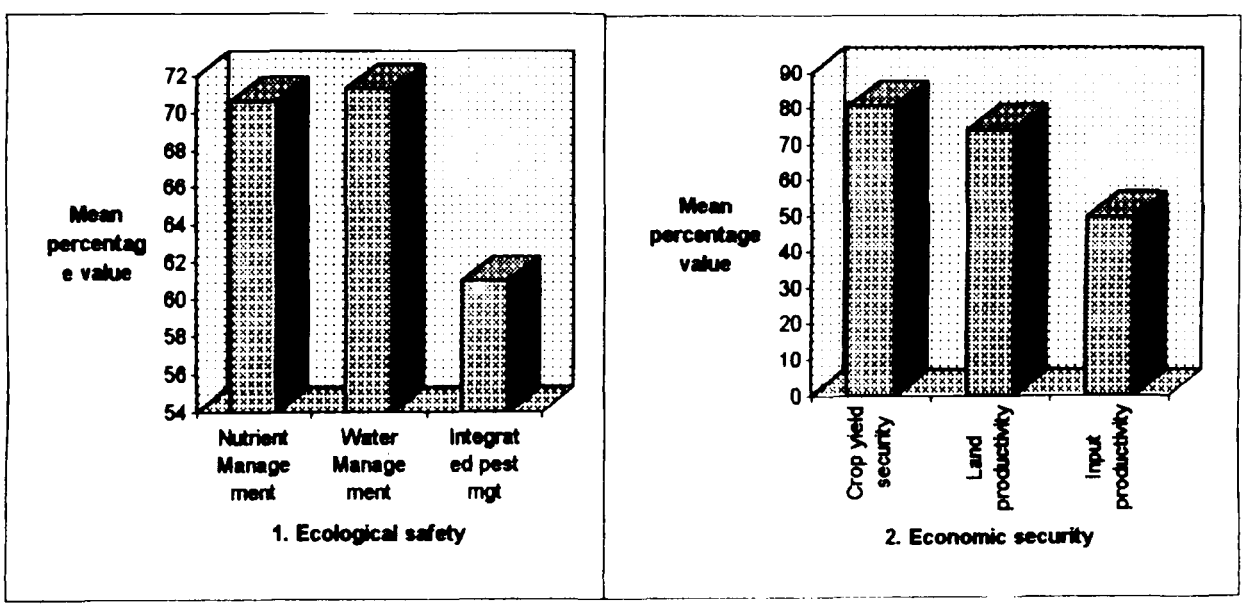
Table I Sustainability level of rice farming system.

N = 50

Dimensions of sustainability	Components of sustainability	Mean percentage values
1. Ecological	A. Nutrient Management	70.63
	B. Water Management	71.33
	C. Integrated pest Management	60.98
2. Economical	A. Crops yield security	80.69
	B. Land Productivity	74.00
	C. Input Productivity	49.72
3. Social	A. Information self reliancy	77.98
	B. Input self sufficiency	44.24
	C. Family food sufficiency	63.77
	Average sustainability level	66.26

Nutrient Management	70.63
Water Management	71.33
Integrated pest mgt	60.98

Crop yield security	80.69
Land productivity	74
Input productivity	49.72



Information self reliancy	77.98
Input self sufficiency	44.24
Family food sufficiency	66.77

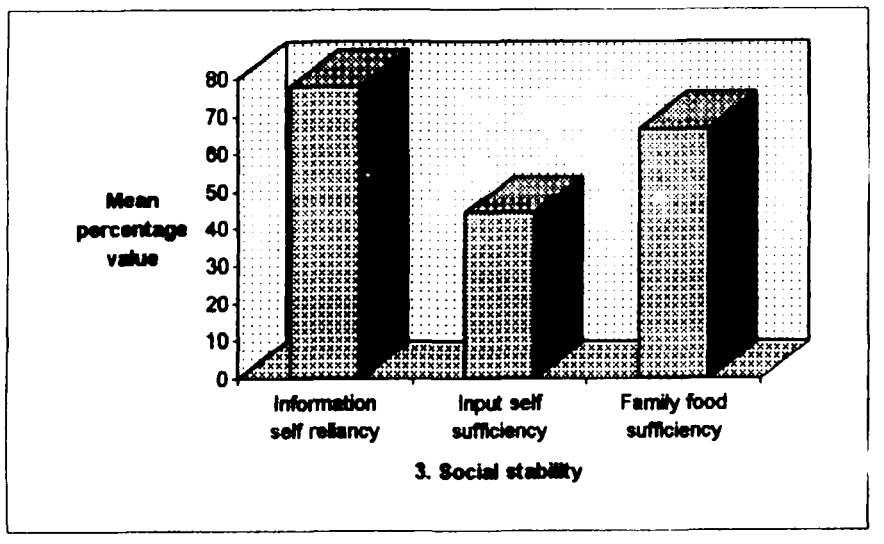


Fig 1 : Sustainability level of rice farming system

B. Sustainability level of sugarcane farming system:

Sustainability level of sugarcane farming was found out by considering the average of mean percentage values of nine indicators of sustainability of sugarcane farming. The result are given in the Table II, and fig 2 show that, integrated pest management of ecological dimension and input self sufficiency of social dimension were having low level of sustainability . Where as input productivity of economic dimension had medium level of sustainability in sugarcane farming.

But, nutrient management, water management and ratoon management of ecological dimension of sustainability, crop yield security and land productivity of economical dimension and information self reliancy of social dimension had high level of sustainability in sugarcane farming system.

As evident from the Table II, on the whole , the sustainability level of sugarcane farming system of Bhadra command area farmers was medium (70.13).

4.2 Comparison of performance of indicators of sustainability of rice and sugarcane farming system :

4.2.1 Performance of components of ecological dimension of sustainability :

4.2.1.1 Nutrient Management :

An examination of Table III, and fig 3 reveals that 't' test value with respect to nutrient management was found to be highly significant , indicating the difference between nutrient management of rice and sugarcane farming. It indicates that nutrient management of sugarcane farming (77.52) had significant difference with nutrient management of rice farming (70.63)

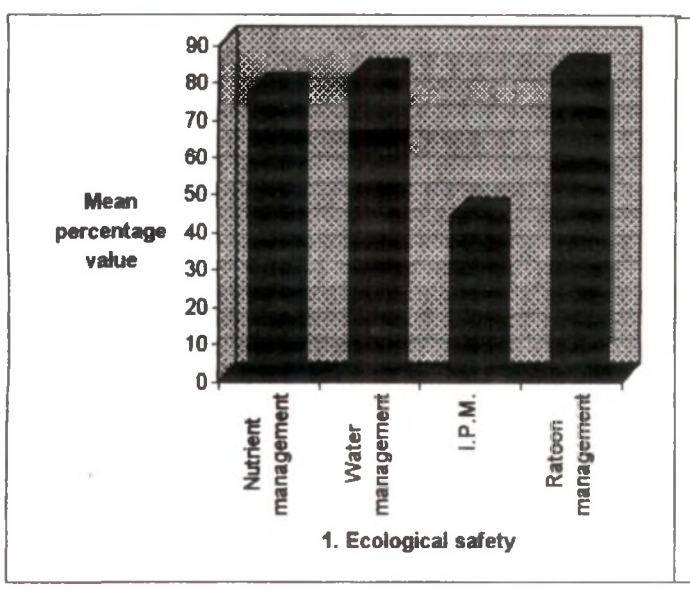
Table II Sustainability level of Sugarcane farming system.

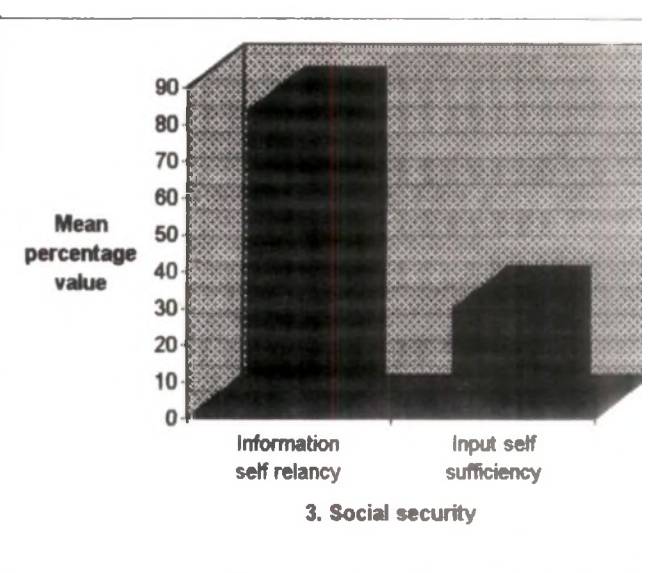
N = 50

Dimensions of sustainability	Components of sustainability	Mean Percentage values
1. Ecological	A. Nutrient Management	77.52
	B. Water Management	81.54
	C. Integrated pest Management	44.38
	D. Ratoon Management	82.80
2. Economical	A. Crop yield Security	84.54
	B. Land productivity	77.33
	C. Input productivity	69.55
3. Social	A. Information self reliency	83.68
	B. Input self sufficiency	29.84
	Average sustainability level.	70.13

Nutrient management	77.52
Water management	81.54
I.P.M.	44.38
Ratoon management	82.8

Information self relancy	83.68
Input self sufficiency	29.84





Crop yield security	84.54
Land productivity	77.33
Input productivity	69.55

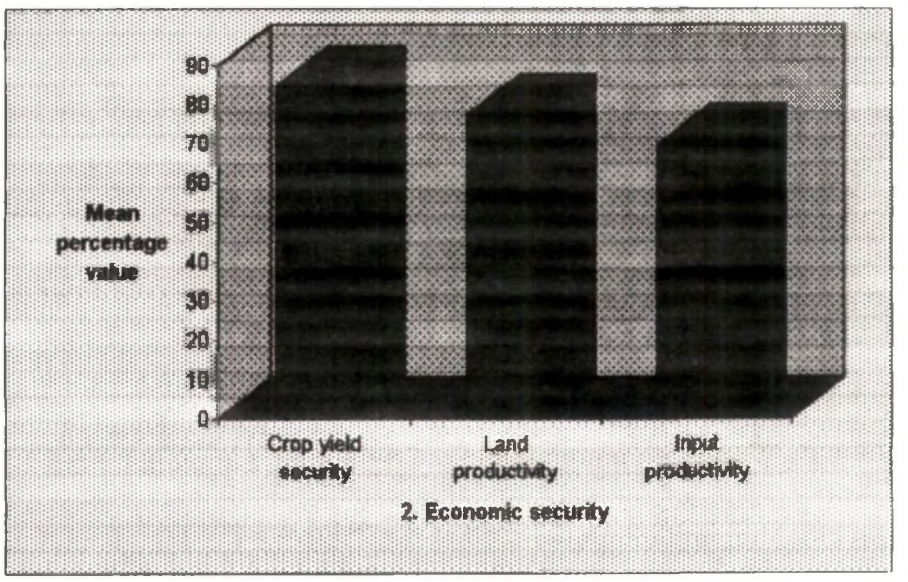


Fig 2: Sustainability level of sugarcane farming system.

4.2.1.2 Water Management :

Mean value of water management of rice and sugarcane farming system differed significantly (Table III and fig 3). Water management with reference to sustainability was much better in sugarcane farming system (81.54) compared to rice farming system (71.33).

4.2.1.3 Integrated Pest Management :

It could be visualised from the Table III and fig 3 that, integrated pest management was better in rice farming (60.98) when compared to sugarcane farming (44.38) . Hence significant difference is observed.

4.2.1.4 Ratoon Management :

Ratoon management of sugarcane farming can not be compared with any component of sustainability of rice farming . Hence it is not compared . However, this practice conceived as sustainable practice by majority of the farmers.

4.2.2 Performance of Components of Economical Dimension of Sustainability :

4.2.2.1 Crop Yield Security :

The Table IV and fig 4 reveales that mean value of crop yield security of rice and sugarcane farming system differed significantly (at 0.01 level) with each other. Hence crop yield security with reference to sustainability was much better in sugarcane (84.54) when compared to rice farming system (80.69) .

4.2.2.2 Input Productivity :

Mean value of input productivity of rice and sugarcane farming differed significantly (at.0.01 level). Hence, input productivity with reference to sustainability was much better in sugarcane farming system (3.13) than in rice farming system (1.84) (Table IV and fig 4).

Table III Comparison of ecological dimension of sustainability of rice and sugarcane farming system.

N = 100

Cropping system	Nutrient Management		Water Management		Integrated pest Management		Sugarcane Ratoon Management
	Mean Value	'T' Value	Mean value	'T' value	Mean value	'T' value	Mean value
Rice	70.63	3.233**	71.33	5.487**	60.98	9.1531**	
Sugarcane	77.52		81.54		44.38		82.80

** Significant at 0. 01 level

I Nutrient Management	70.63	77.52
II Water Management	71.33	81.54
I P M	60.38	44.38

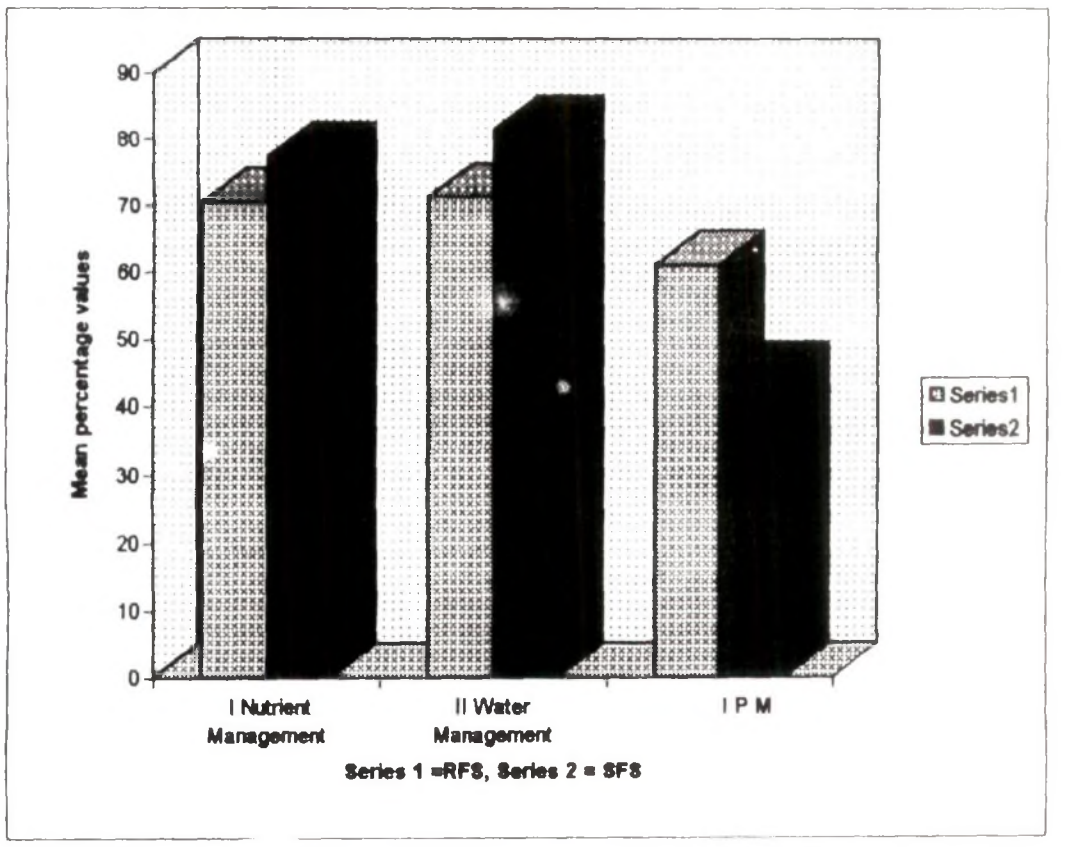


Fig 3: Mean of components of ecological dimensions sustainability of of rice and sugarcane farming system.

Table IV Comparison of economical dimension sustainability of rice and sugarcane farming system .

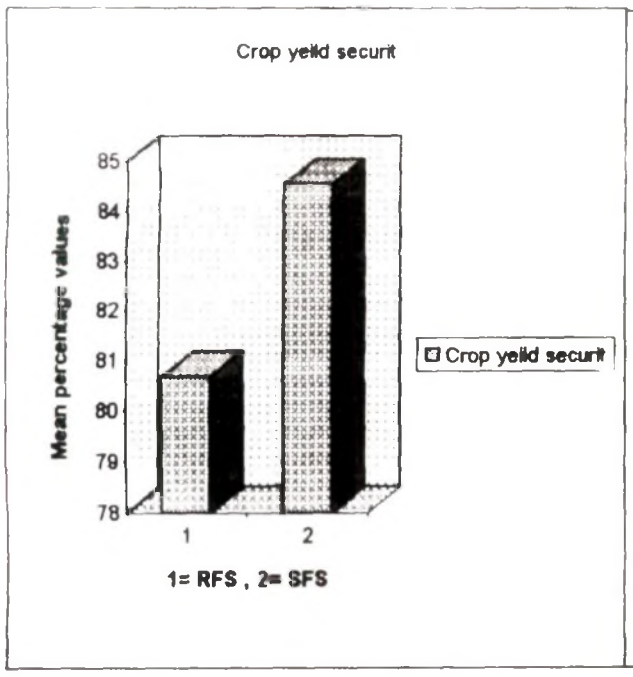
N = 100

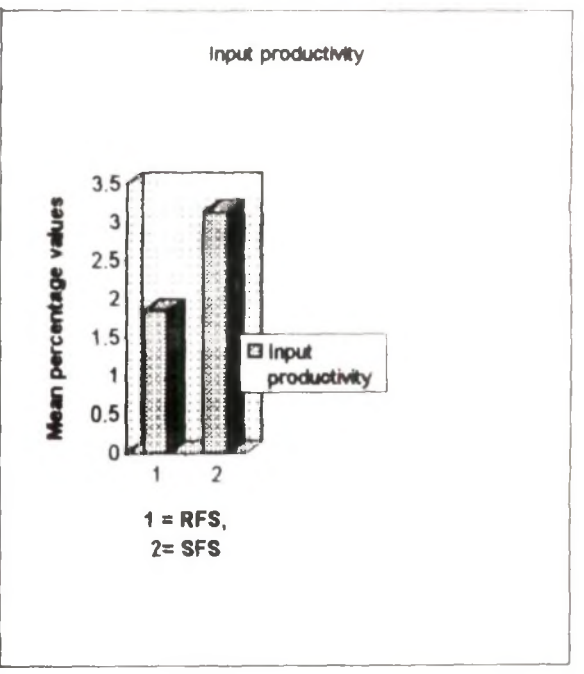
Cropping	Crop yield security		Input Productivity B:C.ratio		Land Productivity ton / ha
	Mean value	T value	Mean value	T value	Mean value
Rice	80. 69	2. 693**	1. 84 (49.72%)	9. 964**	5.55 (74 %)
Sugarcane	84. 54		3. 13 (69.55%)		15.50 (77.33%)

** Significant at 0. 01 level.

Crop yeild securit	80.69	84.54

Input productivity	1.84	3.13





Land productivity	74	77.3

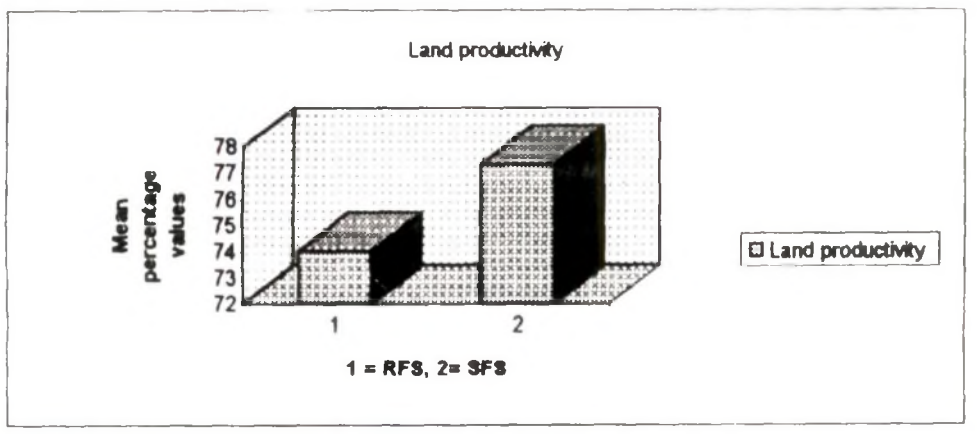


Fig 4: Mean of components of economical dimension of sustainability of rice and sugarcane farming system.

4.2.2.3 Land productivity :

Yield parameters of rice and sugarcane farming system are different and hence it is not compared. But mean values of both rice and sugarcane farming system are found to be good when compared to average yield of that area. Hence land productivity with reference to sustainability was better in both rice (5.55 t /ha) and sugarcane farming system (155 t /ha) (Table IV fig 4).

4.2.3 Performance of Components of Social Dimension of sustainability:

4.2.3.1 Information Self Reliancy :

The Table V and fig 5 reveales that, mean percentage value of information self reliancy of rice and sugarcane farming differed significantly (at 0.05 level) . Hence information self reliancy of sugarcane farmers (83.68) was much better when compared to information self reliancy of rice growers (77.98).

4.2.3.2 Input Self Sufficiency :

Mean value of input self sufficiency of rice farming (44.24) was better when compared to information self sufficiency of sugarcane farming system(29.84). And hence highly significant difference was observed (Table V and fig 5).

4.2.3.3 Family Food Sufficiency :

Family Food Sufficiency of rice can not be compared with components of sustainability of sugarcane farming system and hence it is not compared . Mean value of family food sufficiency of rice farmers (4.14) was found to be better and sustainable with reference to rice farming .

Table V Comparison of Social dimension of sustainability of rice and sugarcane farming system.

N = 100

Cropping system	Information self reliancy		Input self sufficiency		Family food sufficiency
	Mean value	T value	Mean value	T value	
Rice	77. 98		44. 24		4. 14
		2. 609*		7. 286**	
Sugarcane	83. 68		29. 84		

* Significant at 0. 05 level.
** Significant at 0. 01 level.

Information self reliancy	77.98	44.25
Input Sufficiency	83.68	29.84

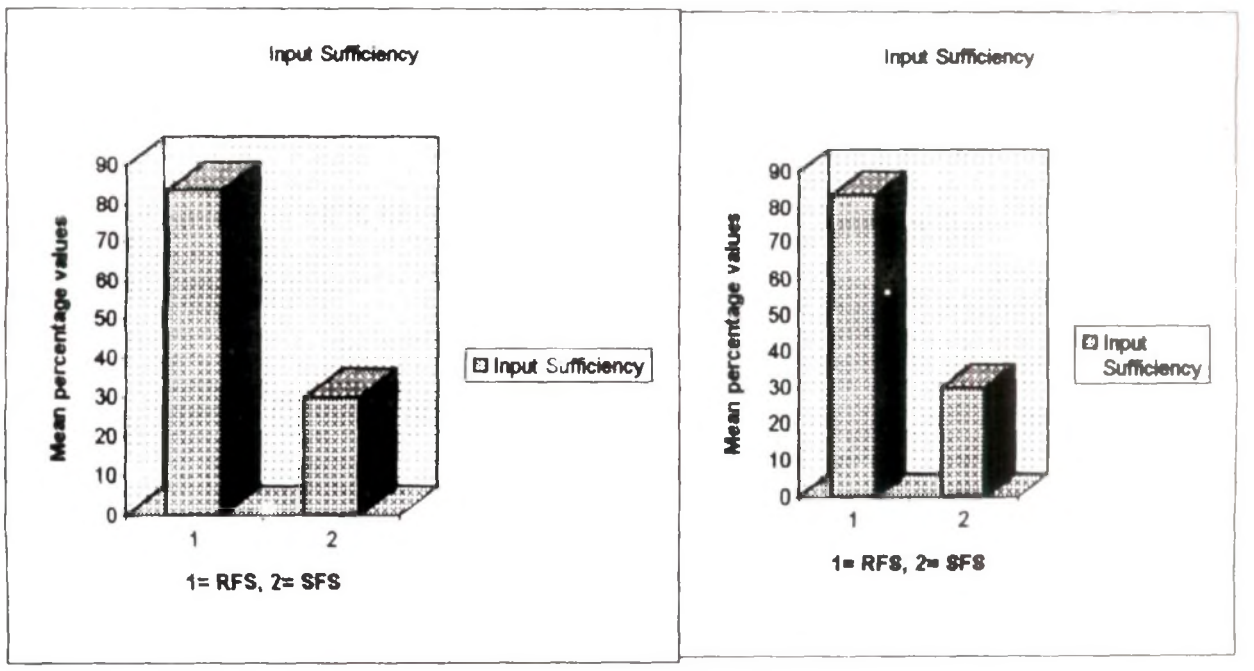


Fig 5. Mean of components of social dimension of Sustainability rice and sugarcane farming .

4.3 Relationship and contribution of independent variables on components sustainability of rice and sugarcane farming system.

Results pertaining to another important dimension of the present investigation explaining the relationship and contribution of the independent variables towards variation in the dependent variable have been presented in this section. The correlation co-efficent have been resorted to identify the influence of independent variables on components of suatainability .The regression coefficient was used to identify the prediction power of all the variables combindly.

4.3.1 Relationship between nutrient management of sustainability and independent variables .

Correlation coefficient, indicating the strength of relationship between independent variables are given in Table VI . The co-efficients of correlation (r) have been tested for significance by comparing with Table 'r' values.

A. Rice farming system:

Of the thirteen factors studied for their relationship with the dependent variable, only farm size was positively and significantly related to nutrient management behaviour of farmers in rice farming. And all other variables were non-significantly related with nutrient management in rice farming.

B. Sugarcane farming system :

On the other hand, education , farm size, innovativeness, attitude towards sustainable agriculture, extension system link , research system link, family size and achievement motivation were positively and significantly correlated with nutreint management behaviour of farmers in sugarcane farming. But values related to agriculture

Table VI Correlation between Nutrient Management of sustainability and Independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	-0.0138	-0.1065
2. Education	0.1708	0.6807**
3. Family size	0.2301	0.3060*
4. Farm size	0.2946*	0.5452**
5. Farming experience	0.0147	0.2584
6. Farming intensity	-0.2360	-0.1116
7. Achievement motivation	0.0611	0.3252*
8. Innovativeness	0.1503	0.5107**
9. Economic motivation	0.1112	0.2331
10. Attitude towards sustainable farming	-0.0209	0.3706**
11. Values related to agriculture	0.0529	0.4346**
12. Extension system link	0.1712	0.4563**
13. Research system link	0.1456	0.3998**

* Significant at 0. 05 level
** Significant at 0. 01 level

is but negatively, but significantly correlated with nutrient management behaviour in sugarcane farming.

4.3.2 Contribution of independent variables on nutrient management.

A. Rice farming system :

The data presented in the table VII reveals that all the 13 independent factors were regressed against nutrient management of sustainablity of rice and sugarcane farming system. The data reveals that, in rice farming all the 13 factors were found to be non-significant in predicting the variation in nutrient management of rice farming. But all the factors put together contributed and explained the variation to the extent of 26.94 per cent in the nutrient management of behaviour of farmers in rice farming.

B. Sugarcane farming system:

The regression co-efficient of two variables, Education and Sugarcane farming intensity were found to be highly significant and Farm size was found to be significant in explaining / predicting the variation in nutrient management of sugarcane farming. But all the 13 factors put together contributed the variation to the extent of 66.30 per cent.

The computed F value (3.16) was significant at one per cent level of probability. So, it can be concluded that all the variables together do explain significant level of variation in the nutrient management behaviour of farmers in sugarcane farming.

4.3.3 Relationship between Water Management of sustainability and independent variables.

Table VIII, gives clear picture of relationship between independent variables and water management of rice and sugarcane farming system.

Table VII Regression analysis of independent variable on nutrient management of sustainability of rice and sugar cane farming system.

N = 100

Independent variable	Rice farming system		Sugarcane farming system	
	Regression Coefficient	't' value	Regression Coefficient	't' value
	n = 50		n = 50	
1. Age	0.1217	0.3781	0.1935	0.8408
2. Education	0.8774	1.3441	2.3981**	3.9000
3. Family size	1.6321	1.3100	0.6161	-1.0037
4. Farm size	1.0771	0.9924	0.8264**	2.3970
5. Farming experience	0.2347	0.8020	-0.2053	-1.0950
6. Farming intensity	-0.0126	-0.1045	0.1788 **	2.7170
7. Achievement motivation	-0.0157	-0.0154	-0.6198	-0.7262
8. Innovativeness	0.5569	0.5049	-0.1718	-0.1297
9. Economic motivation	-0.9039	-0.7238	-2.2165	-1.5004
10. Attitude towards sustainable farming	0.0563	0.0980	0.0776	0.2429
11. Values related to agriculture	0.9981	0.7208	-1.7189	-1.3690
12. Extension system link	-0.3323	-0.5380	0.9031	1.7878
13. Research system link	-0.4385	0.3129	-0.6456	-0.4360

Rice $R^2 = 0.2697$

Sugarcane $R^2 = 66.30$
$F = 5.45^{**}$

* Significant at 0. 05 level
** Significant at 0. 01 level.

A. Rice farming system :

The Table reveals that family size, achievement motivation and attitude towards sustainable farming were positively and significantly related with the water management behaviour of rice growing farmers. On the other hand rice farming experience , economic motivation, values related to agriculture and research system link were negatively and significantly related with the water management behaviour of farmers in rice farming.

B. Sugarcane farming system :

Eight out of thirteen factors, studied possessed significant relationship with water management behaviour of farmers in sugarcane farming sustainability. education, farm size, attitude towards sustainable agriculture and innovativeness were related positively and significantly. While achievement motivation research system link and extension system link had positively significant relationship at 0.05 probability level with dependent variable. But values related to agriculture had negatively and significantly related with water management behaviour of sugarcane farmers.

4.3.4 Contribution of independent variables on water management

A. Rice farming system :

The result of multiple regression analysis presented in Table IX reveals that , regression co-efficients of three variables, rice farming experience, rice farming intensity and innovativeness showed negative significant relationship in predicting the variation in the water management behaviour of rice farmers. But all 13 variables put together contributed to the extent of 57.88 per cent in predicting the variation in water management behaviour of rice farmers.

Table VIII Correlation between water management of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	-0.0588	-0.1750
2. Education	-0.2710	0.6968**
3. Family size	0.2929*	0.2747
4. Farm size	-0.1349	0.4984**
5. Farming experience	-0.4146**	-0.2175
6. Farming Intensity	-0.2220	-0.2582
7. Achievement motivation	0.4550**	0.3309*
8. Innovativativeness	0.1942	0.4067**
9. Economic motivation	-0.3455*	0.2347
10. Attitude towards sustainable farming	0.3843**	0.4127**
11. Values related to agriculture	-0.3289*	-0.3077*
12. Extension system link	0.1880	0.3583*
13. Research system link	-0.3436*	0.3172*

* Significant at 0. 05 level
** Significant at 0. 01 level.

Table IX Regression analysis of independent variables on water management of sustainability of rice and sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression Coefficient n = 50	't' value	Regression Coefficient n = 50	't' value
Age	0.1808	0.7264	-0.1263	-0.6880
Education	0.9441	1.8707	1.6310**	3.3459
Family size	0.9937	1.1908	-0.0092	-0.0189
Farm size	0.0043	0.0051	0.3876	1.4189
Farming experience	-0.5817**	-2.7637	0.0291	0.1959
Farming intensity	-0.1478**	-2.4901	-0.0030	-0.0578
Achievement motivation	1.5400	1.9953	-0.0429	-0.0634
Innovativeness	-2.6608**	-3.1513	-0.6324	-0.6024
Economic motivation	-0.3580	-0.3714	-0.3180	-0.2824
Attitude towards sustainable farming	0.2021	0.4576	0.1024	0.4045
Values related of agriculture	0.8157	-0.7620	0.1096	0.1102
Extension system link	0.0878	0.1842	0.3401	0.8493
Research system link	-0.2108	-0.1946	-0.3245	-0.2764

Rice R^2 = 0-59.88
F = 3.70**

Sugar cane R^2 = 55.51
F = 3.45**

* Significant at 0.05 level

** Significant at 0. 01 level

The computed F values (3.70) was significant at one per cent level of probability . Thus it can be said that all the variables together do explain a highly significant level of variation in nutrient management of rice farming.

B. Sugarcane farming system :

The results in Table IX shows that, only one factor ie., education was found to be highly significant in predicting the variation in water management behaviour of sugarcane farmers. However, all the 13 factors put together contributed to the extant of 55.51 per cent in predicting the variation in water management of sugarcane farming. Thus it can be concluded that all the variables together do explain a highly significant level of variation in water management behaviour of sugarcane farmers.

4.3.5 Relationship between integrated pest management of sustainabilty and Independent variables.

Table X, Provides details related to relationship between independent variables with integrated pest management of both the farming system.

A. Rice farming system:

Education established positive and significant relationship with dependent variable where as 'r' values in respect of farm size, economic motivation and research system link of rice farmers denoted a positive significant relationship at 5 per cent level with integrated pest management behaviour of farmers in rice farming.

B. Sugarcane farming system :

The 'r' values in respect of age and sugarcane farming experience revealed the significant relationship with the independent variable, but negatively, while economic

Table X Correlation between integrated pest management of sustainable independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	0.0232	-0.3149*
2. Education	0.3678**	0.2035
3. Family size	0.0325	-0.1751
4. Farm size	0.3397*	0.1354
5.Farming experience	0.1098	-0.2808*
6. Farming Intensity	-0.1985	-0.0184
7. Achievement motivation	0.1900	0.0697
8. Innovativeness	-0.0153	0.1650
9. Economic motivation	0.3235*	0.3124*
10. Attitude towards sustainable farming	-0.2383	0.0695
11. Values related to Agriculture	-0.0976	-0.0461
12. Extension system link	0.0184	0.2647
13. Research system link	0.3225*	0.1641

* Significant at 0. 05 level
** Significant at 0. 01 level

motivation had positive significant relation with the integrated pest management behaviour of farmers in sugarcane farming.

4.3.6 Contribution of independent variables on integrated pest management.

The results of the multiple regression analysis of integrated pest management of rice and sugarcane farming with independent variables are presented in Table XI.

A. Rice farming system:

The regression co-efficient of only one variable, rice farming experience, was found to be negatively significant in explaining the variation in integrated pest management behaviour of rice farmers. But all the 13 variables contributed to the extent of 40.21 in predicting the variation in integrated pest management behaviour of rice farmres.Hence, all the variables together do explain a highly significant level of variation in integrated pest management of rice farming.

B. Sugarcane farming system :

The regression co-efficient of all independent variables were found to be non-significant in explaining the variation in integrated pest management behaviour of sugarcane farmers. But all the 13 factors put together contributed to the extent of 40.21 per cent in predicting variation in integrated pest management of sugarcane farming system.

Table XI Regression analysis of independent variables on Integrated pest management of sustainability of rice and sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficient	't' value
1 Age	0.5477	1.9959	-0.0241	-0.0991
2. Education	0.8333	1.4973	0.3463	0.5418
3. Family size	0.0955	0.7553	-0.4519	-0.7076
4. Farm size	0.1180	0.1275	-0.2220	0.6196
5. Farming experience	-0.6561**	-2.8269	0.0030	-0.5219
6. Farming intensity	-0.0088	-0.1354	0.0066	-0.0965
7. Achievement motivation	1.3481	1.5442	0.7453	0.8400
8. Innovativeness	-0.5299	-0.5690	0.3959	0.2876
9. Economic motivation	-0.2980	-0.2799	1.7631	1.1941
10. Attitude towards sustainable farming	-0.1856	-0.3811	0.0057	0.0171
11. Values related to agriculture	-0.2111	-0.1788	1.5444	1.1838
12. Extension system link	-0.2698	-0.5130	0.6938	1.3213
13. Research system link	0.6354	0.5319	-0.4670	-0.3031

Rice $R^2 = 0.4021$
$F = 1.81^{**}$

Sugar cane $R^2 = 0.2679$

** Significant at 0.01 level
All variables are Non Significant.

4.3.7 Relationship between crop yield security of sustainability and independent variables .

The data in the Table XII explains the relationship between of the independent variables with crop yield security of rice and sugarcane farming system.

A. **Rice farming system :**

Of the 13 factors , only one factor ie., farm size was significantly related with the crop yield security while, all other 12 independent factors were non-significantly related with crop the yield security of rice farming.

B. **Sugarcane farming system:**

The data in the Table XII , reveals that farm size , family size, achievement motivation and innovativeness had positive and significant relationship with crop yield security behaviour of sugarcane farmers. And other factors were found to have non - significant relationship with respect to crop yield security of sugarcane farming system.

4.3.8 Contribution of independent variables on crop yield security of rice and sugarcane farming system.

The results of the multiple regression analysis are presented in Table XIII. The regression co-efficients of all the independent variables were found to be non-significant in explaining or predicting the variation in crop yield security behaviour of both rice and sugarcane farmers. All the 13 independent variables put together explained the variation extent of 26.59 in rice farming and 31.61 per cent in sugarcane farming respectively.

Table XII Correlation between Crop yield security of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	-0.1010	0.1635
2. Education	0.1782	0.2084
3. Family size	0.0293	0.2800*
4. Farm size	0.3609**	0.2814*
5. Farming experience	0.0706	-0.0826
6. Farming intensity	-0.2671	-0.2357
7. Achievement motivation	-0.0833	0.3447*
8. Innovativeness	0.1386	0.2900*
9. Economic motivation	0.1603	0.0637
10. Attitude towards Sustainable farming	-0.0845	0.0312
11. Values related to Agriculture	0.0024	-0.2784
12. Extension system link	0.2504	0.3194*
13. Research system link	0.2102	0.2182

* Significant at 0. 05 level.
** Significant at 0. 01 level.

Table XIII Regression analysis of independent variables on crop yield security of sustainability of rice and sugarcane farming.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficient	't' value
Age	-0.0640	-0.2783	0.2848	1.3223
Education	-0.0263	0.0505	0.1283	0.2251
Family size	-0.5287	-0.0851	0.6141	1.0797
Farm size	1.2534	1.6162	-0.0649	-0.2030
Farming experience	0.0011	0.0056	-0.2935	-1.6902
Farming intensity	0.0127	0.2310	-0.0205	-0.3370
Achievement motivation	-0.6088	-0.8320	1.1089	1.4020
Innovativeness	0.5766	0.7389	0.4189	0.3910
Economic motivation	-0.6331	-0.7094	-0.1274	-0.0968
Attitude towards sustainable farming	0.0923	0.2261	-0.3764	-1.2716
Values related to agriculture	-0.0223	-0.0225	0.4376	0.3762
Extension system link	0.1109	0.2505	0.6049	1.2911
Research system link	0.5627	0.5019	-1.2057	-0.8787

Rice $R^2 = 0.2659$ Sugarcane $R^2 = 0.3161$

All variables are non - significant

4.3.9 Relationship between reformation self reliancy of sustainability and independent variables.

The data related to the relationship of independent variables with information self reliancy of both rice and sugarcane farming is given in Table XIV.

A. Rice farming system:

As many as eleven independent variables had significant relationship with information self reliancy of rice farmers . Family size , achievement motivation, innovativeness and attitude towards sustainable agriculture were related at one per cent level with rice farming system , while extension system link at 5 per cent level with information self reliancy of rice growing farmers. On the contrary, education, rice farming experience, economic motivation, farm size and values related to agriculture were negatively and significantly related with the information self reliancy of rice growing farmers.

B. Sugarcane farming :

Out of the 13 independent factors, except education, all other factors were found have non-significant relationship with the information self reliancy of sugarcane farmers.

4.3.10 Contribution of independent variables on information self reliancy:

The results of the multiple regression analysis are presented in Table XV.

Table XIV Correlation between information self reliancy of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	-0.0325	0.06311
2. Education	-0.4509**	0.4230**
3. Family size	0.4476**	0.2562
4. Farm size	-0.3093*	0.1750
5.farming experience	-0.5513**	0.0441
6. Farming intensity	0.0229	-0.1563
7. Achievement motivation	0.4113**	0.2610
8. Innovativeness	0.4028**	0.2652
9. Economic motivation	-0.5138**	0.1112
10. Attitude towards sustainable farming	0.5768**	0.1686
11. Values related to agriculture	-0.3242*	-0.2222
12. Extension system link	0.3104*	-0.2356
13. Research system link	-0.5050**	0.1451

* Significant at 0. 05 level
** Significant at 0. 01 level.

A. Rice farming system :

The results showed that two independent variables namely, family size and rice farming experience were found to be significant (at 1 per cent level) and achivements motivation and values related to agriculture were found to be significant (at 5 per cent level) in explaining the variation in Information self reliancy of rice farmers. But all the 13 variables together explained to the extent of 40.91 per cent of variation in information self reliancy behaviour of rice farmers.

The computed F value (4.19) was significant at one per cent level of significance . Thus it can be concluded that all the variables together do explain a highly significant level of variation in information self reliancy of rice growers.

B. Sugarcane farming system:

The results indicated that only one independent variable, education ,was found to be significant (at 5 percent level) in predicting the variation in information self reliancy behaviour of sugarcane growers. And all the variable together do contribute only 29.76 in predicting the variation in information self reliancy behaviour of sugarcane growers.

4.3.11 Relationship between input self-sufficiency of sustainability and independent variables.

The data related to the relationship of independent variables with input self-sufficiency in rice and sugarcane farming is given in Table XVI.

Table XV Regression analysis of independent variables on information self reliancy of sustainability of rice and sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficient	't' value
1. Age	0.0144	0.0513	0.0803	0.4014
2. Education	1.0175	1.7897	1.4413*	2.5337
3.Family size	2.6070**	2.7714	0.7715	1.3580
4. Farm size	-1.0819	-1.1446	-0.4478	-1.4039
5. Farming experience	-0.4888**	-0.0617	0.0120	0.0693
6.Farming intensity	-0.0099	-0.1482	-0.0110	-0.1805
7.Achievement motivation	-0.2176*	-0.2990	0.1636	0.2072
8.Innovativeness	-1.1505	-1.2090	0.0351	0.0291
9.Economic motivation	0.9816	0.9026	0.8292	0.6300
10.Attitude towards sustainable farming	1.0897	2.1905	-0.3870	-1.3093
11.Values related to agriculture	-2.1743*	-1.8031	0.0097	0.0089
12.Extension system link	0.7130	-1.3272	0.6025	1.2892
13.Research system link	-0.5962	-0.4886	-1.6771	-1.2242

Rice R^2 = 0. 6091
F = 4. 19**

Sugarcane R^2 = 2976

* Significant at 0. 05 level
** Significant at 0. 01 level

A. Rice farming system

Of 13 variables , 10 variables, were having significant relationship with sustainability component of input self sufficiency in rice farming . The variables were family size, achievement motivation , innovativeness, attitude towards sustainable agriculture and extension system link were positively and significantly related with input self sufficiency of rice farmers . On the contrary education, rice farming experience, economic motivation, research system link and values related to agriculture were negatively and significantly related with input self sufficiency of rice farmers.

B. Sugarcane farming system:

In sugarcane farming system all the 13 variables had non-significant relationship with input self sufficiency behaviour of sugarcane farmers.

4.3.12 Contribution of independent variables on input self-sufficiency.

The results of the multiple regression analysis presented Table XVII.

A. Rice farming system :

The results showed that, regression coefficients of all 13 independent variables were found to be non-significant in predicting the variation in input self-sufficiency behaviour of rice farmers . However all the 13 factors put together contributed to the extent of 36.84 per cent in predicting the variation in input self sufficiency behaviour of rice growers.

Table XVI Correlation between Input self sufficiency of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	-0.1217	-0.0278
2. Education	-0.4292**	-0.1518
3. Family size	0.2910*	0.1934
4. Farm size	-0.2752	0.1552
5. Farming experience	-0.8916**	0.1033
6. Farming Intensity	0.0372	-0.0139
7. Achievement motivation	0.2946*	-0.0199
8. Innovativeness	0.3322*	-0.2673
9. Economic motivation	-0.4305**	0.2123
10. Attitude towards sustainable farming	0.3349*	0.0128
11. Values related to agriculture	-0.2950*	0.0326
12. Extension system link	0.3584*	-0.1239
13. Research system link	-0.3877*	-0.2164

* Significant at 0. 05 level
** Significant at 0. 01 level.

Table XVII Regression analysis of independent variables on input self sufficiency of sustainability of rice and sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficent	't' value
Age	-0.1108	-0.2858	-0.0690	-0.2855
Education	-0.6540	-0.8371	-0.1356	-0.2086
Family size	0.5560	0.4279	-0.2110	-0.3263
Farm size	-0.3422	-0.2617	0.2821	-0.7766
Farming experience	-0.0886	-0.2701	0.2248	1.1387
Farming intensity	-0.0401	-0.4997	-0.1101	-1.5883
Achievement motivation	0.4548	0.3688	-0.2356	-0.2020
Innovativeness	0.3939	0.2994	-1.3089	-0.9381
Economic motivation	-0.4712	-0.3132	3.1393*	2.0977
Attitude towards sustainable farming	-0.7599	-1.1044	0.2024	0.6014
Values related to agriculture	-0.9078	-0.5803	-0.7270	-0.5498
Extension system link	0.9929	1.3362	-0.0580	-0.1090
Research system link	0.1549	0.0918	-1.8590	-1.5884

Rice R^2 = 0. 3684 Sugarcane : R^2 = 0. 2901

* Significant at 0. 05 level.

B. Sugarcane farming:

Variable viz., economic motivation was significant (at 5% level) in predicting the variation in input self sufficiency behaviour of sugarcane farmers. But all the 13 independent variable put together contributed to the extent of 29.61 per cent in predicting the variation in input self -sufficiency behaviour of sugarcane farmers.

4.3.13 Relationship between land productivity of sustainability and independent variables.

The results of relationship of independent variables with land productivity of rice and sugarcane farming system are given in Table XVIII .

A. Rice farming system:

Correlation co-efficients (r) of, attitude towards sustainable agriculture , and achievement motivation were possessing positive and significant relationship with the land productivity behaviour of rice farmers.

Correlation co-efficients in respect of education, rice farming experience, economic motivation, values related to agriculture and research system link demonstrate the negative and significant relationship with the land productivity behaviour of rice farmers.

B. Sugarcane farming system :

The 'r' values in respect of education, family size, farm size, achievement motivation, innovativeness and extension system link were having positive and significant relationship with land productivity behaviour of sugarcane farmers, while values related to agriculture, research system link and sugarcane farming intensity were negatively but significantly related with land productivity behaviour of sugarcane farmers .

Table XVIII Correlation between land productivity of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' value n = 50	Sugarcane farming system 'r' value n = 50
1. Age	0.0144	0.0892
2. Education	-0.3184*	0.4552**
3. Family size	0,1359	0.39 5**
4. Farm size	-0.2175	0.4497**
5. Farming experience	-0.3170	0.1144
6. Farming Intensity	-0.0480	-0.3169*
7. Achievement motivation	0.3046*	0.3611**
8. Innovativeness	0.2220	0. 3611**
9. Economic motivation	-0.2950**	0. 0127
10. Attitude towards sustainable farming	0.3661**	0.1194
11. Values related to agriculture	-0.2981*	-0.4893**
12. Extension system link	-0.1187	0.5362**
13. Research system link	-0.2971*	-0.5064**

* Significant at 0. 05 level
** Significant at 0. 01 level

4.3.14 Contribution of independent variables on land productivity.

The results of the multiple regression analysis are presented in Table XIX.

A. Rice farming system :

The regression coefficients of all the 13 variables were found to be non-significant in explaining the variation in land productivity behaviour of rice growers. But all the components put together explained to the extent of 35.49 per cent of variation in land productivity behaviour of rice farmers.

B. Sugarcane farming system :

Here also the coefficients of all the 13 variables were found to be non-significant in explaining the variation in the land productivity behaviour of sugarcane growers. But all the 13 variables put together explained to the extent of 59.27 per cent of variation in land productivity behaviour of farmers in sugarcane farming system. Thus it can be concluded that all the variables together do explain a highly significant level of variation in land productivity behaviour of sugarcane growers.

4.3.15 Relationship between input productivity of sustainability and independent variables

Results of correlation coefficients are presented in Table XX.

A. Rice farming system.

It is clear from table that, education, farms size, economic motivation, research system link and rice farming experience are positively and significantly related with the input productivity behaviour of rice growers . But, it is an interesting to note that attitude

Table XIX Regression analysis of independent variable on land productivity of sustainability of rice and sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficient	't' value
Age	0.0491	0.7313	0.1892	0.9053
Education	-0.1102	-0.8093	0.9719	1.8050
Family size	0.0817	0.3629	0.6034	1.1230
Farm size	-0.1074	-0.4793	-0.0052	0.2101
Farming experience	-0.0867	-1.5208	-0.2089	-1.2739
Farming intensity	-0.0114	-0.7139	0.0426	0.7401
Achievement motivation	0.0707	0.3575	0.3512	0.4701
Innovativeness	-0.2322	-1.0190	1.2611	1.0878
Economic motivation	-0.0591	-0.2207	-1.9859	-1.5971
Attitude towards sustainable farming	0.1707	1.4322	-0.5192	-1.8387
Values related agriculture	-0.4232	-1.4657	-0.7162	-0.6519
Extension system link	-0.2259	-1.7556	0.6650	1.5039
Research system link	0.4047	1.3843	0.5698	0.9396

Rice $R^2 = 0.3549$

Sugarcane $R^2 = 0.5927$
$F = 4.03^{**}$

All variables are non significant
** F value Significant at 0. 01 level

towards sustainable agriculture was negatively and significantly related with the input productivity behaviour of rice farmers.

B. Sugarcane farming system :

Correlation (r) values of education, family size, innovativeness , extension system link, attitude towards sustainable agriculture, research system link were positively and significantly related with the input productivity behaviour of rice farmers . On the other hand values related to agriculture possessed negative and significant relationship with the input productivity behaviour of sugarcane farmers .

4.3.16 Contribution of independent variables on input productivity .

The results of the multiple regression analysis are presented in Table XXI.

A. Rice farming system :

The results depicted that out of the 13 variables, innovativeness was positively significant (at 5% level) in predicting the variation in input productivity behaviour of rice farmers. But all the 13 factors put together contributed to the extent of 51.39 per cent in predicting the variation in input productivity behaviour of rice farmers. Thus it can be concluded that all the variables together do explain a highly significant level of variation in input productivity behaviour of rice farmers.

B. Sugarcane farming system :

The variables such as economic motivation and values related to agriculture had negatively significant relationship (at 5% level) and education had positive significant relationship (at 5% level) in predicting behaviour of sugarcane growers . But all the 13 factors put together contributed to the extent of 63.07 per cent in predicting the variation in input productivity behaviour of sugarcane farmers. Thus it can be concluded that all the

Table XX Correlation between input productivity of sustainability and independent variables.

N = 100

Factors	Rice farming system 'r' values n = 50	Sugarcane farming system 'r' values n = 50
1. Age	0.0277	0.1796
2. Education	0.4166**	0.4430**
3. Family size	0.0178	0.3990**
4. Farm size	0.5655**	0.2633
5. Farming Experience	0.3523*	-0.0401
6. Farming intensity	-0.2347	-0.1920
7. Achievement motivation	-0.0615	0.2029
8. Innovativenes	0.0864	0.5790**
9. Economic motivation	0.4680**	-0.1092
10. Attitude towards sustainable Agriculture	-0.3733**	0.2987*
11. Values related agriculture	-0.0084	-0.4503**
12. Extension system link	0.2038	0.4345**
13. Research system link	0.5095**	0.4334**

* Significant at 0. 05 level.
** Significant at 0.05 level.

Table XXI Regression analysis of independent variables on input productivity of sustainability of rice & sugarcane farming system.

N = 100

Factors	Rice farming system		Sugarcane farming system	
	Regression coefficient	't' value	Regression coefficient	't' value
Age	0.0077	0.4705	0.0304	1.8916
Education	-0.0566	-1.1101	0.0960*	2.2596
Family size	0.0100	0.1826	0.0078	0.2322
Farm size	0.0603	1.2061	-0.0195	0.8175
Farming experience	-0.0006	-0.0033	-0.0158	-0.2191
Farming intensity	0.0048	1.1172	0.0090	1.9799
Achievement motivation	-0.0146	-0.2813	-0.0009	-1.1553
Innovativeness	0.1397*	2.5238	0.1202	1.3137
Economic motivation	0.0296	0.3882	-0.2020*	-2.6703
Attitude towards sustainable farming	-0.0125	-0.4322	0.0093	-0.4285
Values related to agriculture	0.0083	0.1181	-0.1750*	2.0194
Extension system link	0.0117	0.7752	0.0579	1.6600
Research system link	0.0516	0.7265	0.0539	0.1023

Rice $R^2 = 0.5139$
$F = 2.85^{**}$

Sugarcane $R^2 = 0.6307$
$F = 4.73^{**}$

* Significant at 0. 05 level
** Significant at 0. 01 level.

variables together do explain a highly significant level of variation in input productivity behaviour of sugarcane growers.

4.3.17 Relationship of family food sufficiency of rice farming with independent variables

Table XXII , gives clear picture that, of the 13 factors , nine factors possessed significant relationship with family food self sufficiency behaviour of in rice farmers system.The factors like education, farm size, rice farming experience , economic motivation and research system link were positively and significantly related to family food sufficiency behaviour of rice farmers. Achievement motivation, innovativeness , attitude towards sustainable agriculture and family size were negatively and significantly related to family food self sufficiency behaviour of rice farmers.

4.3.18 Contribution of independent variables on family food sufficiency of rice farming .

The results of the multiple regression analysis presented in Table XXIII , shows that farm size, rice farming intensity, innovativeness and economic motivation were highly significant (at . 1% level) in predicting the variation in family food sufficiency behaviour of rice farmers. However, all the 13 independent variables put together contributed to the extent of 94.01 per cent in predicting the variation in family food self -sufficiency of rice farmers. Thus it can be concluded that all the variables together do explain a highly significant level of variation in family food sufficiency of rice farming.

Table XXII Correlation between family food sustainability of rice farming with independent variables.

N = 50

Factors	Rice farming system 'r' value
1. Age	-0.0935
2. Education	0.8896**
3. Family size	-0.3408*
4. Farm size	0.7984**
5. Farming experience	0.6909**
6. Farming intensity	-0.2433
7. Achievement motivation	-0.4091**
8. Innovativeness	-0.4097**
9. Economic motivation.	0.9440**
10. Attitudes towards sustainable farming	-0.8507 **
11. Values related to agriculture	0.2361
12. Extension system link	-0.1809
13. Research system link	0.9325**

* Significant at 0.05 level
** Significant at 0.01 level

Table XXIII Regression analysis of in !ependent variables on family food sufficiency of sustainability of rice farming system.

N = 50

Factors	Rice farming system	
	Regression coefficient	' t' value
Age	-0.0157	- 0.5105
Education	0.0966	-1.5507
Family size	0 .0777	-0.7533
Farm size	0.2807**	2.7102
Farming experience	0.0114	0.4396
Farming intensity	0.0207**	2.8237
Achievement motivation	-0.1336	-1.3674
Innovativeness	0.3680**	3.5306
Economic motivation	0.4015**	3.3686
Attitude towards sustainable farming	-0.0130	-0.2389
Values related to agriculture	0.0833	0.6304
Extension system link	-0.0524	-0.8093
Research system link	-0.0762	-0.5901

Rice R^2 = 9401

F = 44. 23**

** Significant at 0. 01 level.

4.3.19 Relationship of ratoon management behaviour in sagarcane farming system with independent variable.

Table XXIV, clearly indicates that farm size and extension system link achievement motivation, innovativenous , research system link were positively and significantly possessed relationship with the ratoon management behaviour of sugarcane farmers .But values related agriculture possessed negatively significant relationship with ratoon management behaviour sugarcane farmers.

4.3.20 Contribution of independent variables on ratoon management in sugarcane farming .

The results of multiple regression analysis presented in the Table XXV , Shows that only farm size was positively significant (at 5% level) in predicting the variation in ratoon management behaviour of sugarcane farmers. But all the 13 independent variables put together contributed to the extent of 44.61 per cent in predicting variation in ratoon management behaviour of sugarcane growers. Thus it can be concluded that all the variables together do explain a highly significant level of variation in ratoon management behaviour of sugarcane farmers.

4.4 Reasons for low sustainability of rice and sugarcane farming system:

When the reasons were analysed for the low sustainability of both the farming system, it could be attributed to its performance on various components of sustainability. Specific reasons are presented in Table XXVI.

Table XXIV Correlation between ratoon management with independent variables.

N = 50

Factors	Sugarcane farming system 'r' value
1. Age	-0.0983
2. Education	0.1302
3. Family size	-0.1254
4. Farm size	0.4560**
5. Farming experience	0.0017
6. Farming intensity	-0.1593
7. Achievement motivation	0.3222*
8. Innovativeness	0.3414*
9. Economic motivation	0.1347
10. Attitudes towards sustainable farming	-0.0764
11. Values related to agriculture	-0.3506*
12. Extension system link	0.4561**
13. Research system link	0.3505*

* Significant at 0.05 level

** Significant at 0.01 level

Table XXV Regression analysis of independent variables on ratoon management of sustainability of sugarcane farming system.

N = 50

Factors	Sugarcane farming system	
	Regression coefficient	't' value
Age	-0.5087	-1.7456
Education	-0.5008	-0.6408
Family size	0.0224	0.0291
Farm size	1.0169*	2.3532
Farming experience	0.2521	1.0732
Farming intensity	0.0986	1.1956
Achievement motivation	1.6707	1.5616
Innovativeness	1.3007	0.7835
Economic motivation	-0.0017	-1.1242
Attitude towards sustainable farming	-0.5341	-1.3339
Values related to agriculture	-0.4909	-0.3117
Extension system link	0.5634	0.8898
Research system link	-0.2781	-0.1499

Sugarcane R^2 = 44. 61
F = 2. 18**

* Significant at 0. 05 level.
** Significant at 0. 01 level.

Reasons for low sustainability of rice farming system :

Most of the rice growers (80%) were not tested their soil for soil fertility and for its health . The analysis of reasons given by the farmers revealed that application of less organic manure (42%), non- application of bio-fertilizers (66%), imbalance in use of inorganic manure (80%), non-use of soil amendments (68%) and non - use of micro-nutrients (68%) lead to poor nutrient management .

In the rice farming system , farmers did not have control over standing water in the fields at different stages of crop growth, especially during , prior and after application of fertilizers (58%) and majority (68%) did not give attention towards depth of water impounded in these paddies irrespective of stage of crop. Some farmers who were having saline and alkaline soils could not take up proper water management practices, thus leading to poor water management .

Integrated pest management practices were not adopted by majority of farmers as evident from cent percent dependency on chemical means to control pest. The farmers were not utilizing the advantages of diversified cropping system. Majority of the paddy farmers (70%) were not adopting precautionary measures to the full extent resulted in poor nutrient management.

Other important factors that had contributed for low sustainability of rice farming were dependency on purchased inputs (74%), dependingly on hired labour (80%) , dependency on chemicals & fertilizers and low research system link (40%) etc.

Table XXVI Reasons for low sustainability in rice and sugarcane farming system as perceived by farmers.

	Rice		Sugarcane	
	No.	%	No.	%
1. Soil testing is not performed	40	80%	30	60%
2. Inadequate use of organic manure	21	42%	37	74%
3. Non application of green manure	24	48%	13	26%
4. Non-application of bio - fertilizer	33	66%	42	84%
5. Imbalance in use of inorganic fertilizer	40	80%	20	40%
6. Excess use of inorganic fertilizer	20	40%	6	12%
7. Non use of Soil amendments	34	68%	33	66%
8. Non use of Micro nutrients	24	48%	27	54%
9. Non-control over standing water in fields.	29	58%	7	14%
10. No crop rotation	45	90%	5	10%
11. Inadequacy of precautionary measures	35	70%	5	10%
12. Dependency on chemicals and fertilizers	50	100%	50	100%
13. Land productivity (< 2.43)	43	86%	10	20%
14. Dependency on hired labour	40	80%	50	100%
15. Dependency on purchased inputs	37	74%	48	96%
16. Lack of sugarcane based crop residue management	_	_	37	74%
17. Lack of sugarcane based cropping system (Inter cropping)	_	_	50	100%
18. Marketing problems	_	_	40	80%

Reasons for low sustainability of sugarcane farming system :

In sugarcane farming system, dependency on chemical fertilizer (100%), dependency on hired labour (100%) , dependency on purchased inputs (96%) etc. were the main reasons for low sustainability . Even though they were aware of sugarcane based cropping system, cent percent of sugarcane farmers were not following inter cropping. The vulnerability of this system is the problems related marketing of sugarcane crop at right time.

Along with these, lesser use of organic manure (74%), non application of bio-fertilizers (84%) , non-use of soil amendments followed by non-use of micro nutrients and non- performance of soil testing (60%) were the main problems encountered for low sustainability in sugarcane farming system.

Discussion

V DISCUSSION

The results of the study presented in preceeding chapter are interpreted and discussed in this chapter. As the research area is new, the related studies are scarce. The supporting or contradicting of the research results of the present study is done through theoretical background and researchers understanding of the situation. The results are discussed under following heads.

5.1 Sustainability level of rice and sugarcane farming system

5.2 Comparison of performance of indicators of sustainability of rice and sugarcane the farming system.

5.3 Relationship and contribution of independent variables on indicators of sustainability of rice and sugarcane farming system.

5.4 Reasons for low sustainability of rice and sugarcane farming system.

5.1 Sustainability level of rice and sugarcane farming system :

Comprehensive Table I & II, reveals that rice and sugarcane farming system were having medium level of sustainability . The mean percentage scores of rice and sugarcane farming were 66.26 and 70.13 respectively. The medium level of sustainability in rice farming system is due to low input productivity and input self -sufficiency and this has very vividly reflected in results as shown in Table I. On the other hand, low integrated

management behaviours and very low input self-sufficiency behaviour caused medium level of sustainability in sugarcane farming system.

The other reasons for difference in indicators of sustainability were discussed in preceeding tables.(Table II) rice and sugarcane farming were having almost equal level of sustainability. It may be due to the locale of the study i.e., the study was taken in same area of adjacent villages, with same soil, climate and water facilities. Farmers studied were from the same situation and condition. The farmers growing sugarcane were also growing rice for their livelyhood and vice-versa. Increased cosmopoliteness and their awareness of danger due to excess use of chemicals and fertilizer and favourable attitude towards sustainable agriculture by the farmers of this area might have contributed to medium level of sustainability in both rice and sugarcane farming .

5.2 Comparison of performance of indicators of sustainability of rice and sugarcane farming system.

5.2.1 Comparing the components of ecological dimension of sustainability of rice and sugarcane farming system.

The results provided in Table III have been discussed below under the respective components.

5.2.1. 1 Nutrient Management :

Nutrient management was better in sugarcane farming system than in rice farming system. It is because there were some differences in the ways the nutrient management in rice and sugarcane farming system . More use of organic manure, mixing press mud and crop residue of leguminous crops and mulching practices combinedly have resulted in better nutrient management in sugarcane farming system. Whereas increasing reliance an

chemical fertilizers in the irrigated system with absence of integrated nutrient management, reduced livestock possession and non availability of green leaf manure lead to poor nutrient management in rice farming system compared to sugarcane farming system. Lesser sustainability in rice farming system when compared to sugarcane farming system might be due to the fact that, farmers have not bothered to replenish the exhausted micronutrients . Further, soil amendment was performed by very few farmers. Also water management after the fertilizer application might have lead to leaching of nutrients. All these factors in rice farming might have resulted in poor nutrient management in rice farming system when compared to sugarcane farming system.

5.2.1.2 Water Management :

The reasons for the slightly poor water management in rice farming system when compared to sugarcane farming system (Table III) might be due to the flooding type of irrigation being followed before and after fertilizer application and at certain stages of crop growth ie., at the initial 10 days of planting and at tillering stage. Also due to the peculiar irrigation method followed by them. ie., irrigating the field plot wise. Further , very few farmers have practiced mulching atleast during summer season and this might have contributed to poorer water management in rice farming compared sugarcane farming. Interestingly, sugarcane farmers, though they followed the same irrigation method, better water management scores were obtained by the farmers because of its inherent quality of giant grass and crop can withstand flooding type of irrigation. In addition to the above reason, the farmers of this area were also practicing mulching practices during summer and hence water management score was little higher in sugarcane farming when compared to rice farming . Thus one can conclude that water management was slightly better in

sugarcane farming system when compared to rice farming system. Thus overall results call for change in improvements in the scientific management of water in rice farming system, and especially in problematic soil in both rice and sugarcane system.

5.2.1.3 Integrated Pest Management :

Integrated Pest Management behaviour of rice growing farmers was certainly better than sugarcane growing farmers (Table - III) . Sugarcane growers follow only prophylactic measures to control pests , diseases and weeds . This trend might have resulted low integrated pest management in sugarcane farming system. Further more there was less accurance of pest and diseases on sugarcane crop. And this might have added to the above trend. Integrated Pest Management behaviour was considerably higher in rice farming because of the frequent accurance of pests like leafroller,thribs, mealy bug, cutwarm and stem borer, diseases like blast,sheathblight and leafblight and due to the problem of weeds. Since the zone was more prone to above pest, diseases and weeds in rice farming, the agricultural department have done lot of extension work in promoting integrated pest management. This might have also contributed for the higher integrated pest management behaviour among rice growers.

Crop rotation in rice farming is far from sight in Bhadra command area . Farmers grow only paddy after paddy . ie., monocropping is prevalent in this area. This has resulted in frequent accurance of pest & diseases in rice crop. To overcome this m[illegible]aces farmers are restored to the combination of control methods to check the pest and diseases under control . Hence the above trend was observed among the rice growers with respect to IPM when compared to sugarcane growers.

5.2.1.4 Ratoon Management in sugarcane farming :

Ratoon Management in this farming was practiced by most of our farmers (82.80%). The nutrient management, water management what they were practicing for the main crop were also practiced in ratoon crop. And also all the care was taken by them to have a good ratoon crops. It is quite natural in sugarcane crop that farmers will go for normally 2-3 ratoon crops. and it is experiences of the farmer that, more yield / ha was obtained by them in ratoon crops . Hence farmers do practice all recommended packages as they were practised for the first crop. Ratoon management by the farmers was certainly better and it is reflected in the mean percentage value. Since most of the farmers do not practices the mulching in the crop, the sustainability in this farming system was reduced to some extent. However the sustainability in ratoon crop of sugarcane was on higher side .

5.2.2. Components of economic dimension :

Discussion of the results related to the level of crop yield security, input productivity and land productivity in both the farming system are presented in Table IV.

5.2.2.1 Crop yield security :

Crop yield security of rice and sugarcane farming significantly differed with each other. Sugarcane farming had better crop yield security than rice farming . The rice farming system had higher external threats compared to sugarcane farming ie., most of the farmers were using some varieties viz., Jaya , Jyoti which lead to higher incidence of pest and disease; water scarcity in summer, labour scarcity during harvesting time etc.

Added to this the non availability of skilled labour during different reasons also resulted in lesser sustainability of production in sugarcane crop. However, the sustainability

in sugarcane farming system is better than rice farming system, and it is reflected in the mean percentage values. This finding is in line with the findings of Nadakarni (1993), who stated that, agricultural system may be highly productive but it is subjected to substantial risks as for as their sustainability is concerned because of marketing , non availability of skilled labour and alike.

5.2.2.2 Input Productivity :

The sustainability in reference to input productivity is lower in rice farming system. and of medium type in sugarcane system (Table IV). Sugarcane farming was found better than rice farming in input productivity. This is due to the returns per unit of investment in rice and sugarcane farming system and they have also been presented in Table IV. Input productivity is otherwise taken as profitability when total variable cost is taken into consideration. The value of total out put was more nearly three times than the cost of inputs in sugarcane farming.

Higher application of purchased inputs like chemicals and fertilizers and larger labour wages and at the same time the minimum supporting price for rice was the cause for the lower input productivity in rice farming system. Sugarcane crop getting higher yield because of its commercial nature with good price for crop might have lead to little higher input productivity in sugarcane farming system.

The main and by-products of sugarcane is having commercial value. Therefore the value of the total produce will be higher than those crops which do not possess. This reason might have lead to higher input productivity in sugarcane farming system (3.13 B:C ratio) than the rice farming system (1.84 B.C.ratio) . Therefore a significant difference was observed between the mean percentage scores of rice and sugarcane crop.

5.2.2.3. Land Productivity :

Mean values of land productivity of both rice and sugarcane farming were found to be average (5.55 tons / ha and 155 tons / ha) . This is due to better over all nutrient management practices, water management practices, crop yield security and input productivity, research system linkof the farmers and this is reflected in the results (Table III and IV).Land productivity is the ratio of obtained yield to the expected yield. The expected yield of these crops were 7.50 tons /ha (grains) and 200 tons / ha of (cane). The farmers have obtained an average yield in rice & sugarcane crop because of poor input self sufficiency and average integrated pest management.

5.2.3 Components of Social Dimension :

Results pertaining to the three components of social dimension of rice farming and two dimension of sugarcane farming have been presented in Table V, and they are discussed below separately.

5.2.3.1 Information Self - sufficiency :

Information self sufficiency also found to be significantly better in sugarcane farming system. This is because the sugarcane farmers of this area have experienced repeated economic success over the years. The urge to aspire and achieve more and more might have simultaneously influenced them in knowing more which is a precurser to do better . Also the trusted package of practices have enabled to aquire mastery over the routine operations other than critical situations. Because of frequent accurance of pest & disease in rice farming , farmers have lost yield considerably in previous years and this might have motivated them to consult more with others to achieve sustained yield . This

phenomena resulted in higher information seeking behaviour among paddy farmers and hence there is significant difference between the mean percentage values of rice farming system and sugarcane farming system.

5.1.3.2 Input Self-sufficiency :

Dependency for purchased inputs was found to be more in sugarcane farming system compared to rice farming system.However, input self sufficiency of sustainability in both the farming system is low (less than 50). This interesting finding reveals that farmers of this area are dependent on inputs like seed , FYM / compost, green manure, fertilizers, equipments, etc., completely. Further it also indicates that, they are not utilizing the locally available inputs like FYM / compost, green manure labour, either human or animals.Hence the external dependency on the inputs is rather more in sugarcane farmers than rice farmers.

5.3.1.3 Family Food Sufficiency :

This dimension pertains only to rice crop but not to sugarcane crop. Because rice is used as main food crop in this region.The value in the Table V indicates that most of the farmers have produced surplus rice (4.14 FFS ratio.) . This is because, farmers might have considered the paddy not only as food crop but also as commercial crop. Further, the farmers can not grow other crops profitably than rice crop because of the soil and irrigation condition in that area. And further, rice is primarily grown to meet the needs of farm family .

5.3 Relationship and contribution of independent variables on indicators of sustainability of rice and sugarcane farming system

5.3.1 Relationship between nutrient management of sustainability and independent variables

The correlation coefficients indicating the strength and direction of relationship of nutrient management of rice and sugarcane farming have been presented in Table VI.

A. Rice farming system :

Farm size exhibited positive and significant relation ship with the nutrient management behaviour of rice growers . Larger the farmer size lesser the pressure on natural resources (Chandre gouda 1994) and collectively other factors might have influenced the nutrient management behaviour of rice farmers . This finding is in accordance with the finding of Rao (1985), Bora & Ray (1986), Gogoi & Gogoi (1989), Patel (1994) and Chandre gouda (1996).

B. Sugarcane farming system:

Family size , education , farm size, achievement motivation, innovativeness , attitude towards sustainable farming, extension system link and research system link possessed positive and significant relationship with nutrient management behaviour of sugarcane farmers (Table VI.).

It is quite natural that better education of the farmers help them to understand the benifits of conservation of natural resources, including land and water (Hendee, 1969), Higher education couple with farm size would naturally put lesser pressure on natural resources (Chandregowda, 1996). Further , higher education with bigger farm size will

make the individual to become self-reliant in information. In addition, family size would also naturally contribute for better nutrition management. Thus education, family size & farm size, are positively & significantly related with the nutrient management behaviour of sugarcane farmers.

The earlyness of farmers in adopting techonologies will always bring windfall benefits to them and they will be always in forefront in the adoption of the technology. Therefore innovative farmers are likely to become aware about the dangerous of soil degradation. Hence innovativeness established positive and significant relationship with the nutrient management behaviour of sugarcane growers.

Further, psychological factors like achievement motivation, attitude towards sustainable agriculture and value orientation factors would help the farmers to promote sustainable farming through their synergetic effects; one helping other to have positive relation. Similar results were also observed by Rao (1985) and Bora and Ray (1986), and Chandregowda (1996)

Communication factors like linkage with research extension systems have exhibited significant relationships owning to their knowledge generation and knowledge imparting responsibilities. Lancini (1987) ,Saltiel ,et.al., (1994),and Patel, et.al., (1994) have reported similar findings in different circumstances. But values related to agriculture was negatively correlated with nutrient management. ie., Farmers who possess values towards agriculture will be having less knowledge or not aware of how best inorganic, micronutrients and soil amendments can be utilised. This finding is in line with findings of Rao (1985) and Bora (1986).

5.3.2. Contribution of independent variables on nutrient management .

A. Rice farming system:

A glance at the Table VII indicates none of independent variables have made significant contribution in explaining the variation of sustainability of nutrient management behaviour of rice farmers . However, 26.97 per cent of the variability is contributed in presence of all the variables . There may be other variables or factors which may probably contribute to the variability of nutrient management in sustainability of rice farming system. Hence the above finding.

B. Sugarcane farming system :

A perusal of the Table VII projects that the variables education, farm size and sugarcane farming intensity had significantly contributed in explaining the variation in the nutrient management behaviour of sugarcane farmers . All the variables together have contributed to the extent of 66.30 percent in predicting variation in nutrient management of sustainability of sugarcane farming. Significant 'F' value confirms the enormity of contribution.

We know educated farmers could be able to use integrated nutrient management in a better way because of their knowledge about the balanced and calculated fertilizer application and the ill effects of high dose of fertilizer. This finding is supported by the findings of Patel et. al., (1994), Bora and Ray (1986).

Farm size with higher sugarcane farming intensity lead to better nutrient management .It might be due to higher the farm size lesser the pressure on natural resources and this might have lead to better nutrient management behaviour. High sugarcane farming intensity owe to get higher profits . Since sugarcane is a commercial

crop, the farmers might have motivated to have better nutrient management in sugarcane farming. This finding is in line with the findings of Patel ,et. al., (1994), but contradicts with the finding of Chandre gowda (1996)

5.3.3 Relationship between Water management of sustainability and independent variables.

Results in Table VIII shows relationship pattern between independent variables and water management behaviour of farmers .

A. Rice farming system :

Family size, achievement motivation, attitude towards sustainable agriculture are positively and significantly related with water management behaviour of rice farmers.

If family size is more , then family members can contribute a lot to the farming, by way of participating in different farming activities . Achievement motivation and favourable attitude towards sustainable agriculture might have lead to synergic effects for proper and efficient use of water. Findings are in line with the findings of Gowda (1991), Bens and Dunlop (1994), Saltiel, et. al., (1994) and Chandregowda (1996).

On the other hand Rice farming experience and economic motivation, values related to agriculture and research system link were negatively and significantly correlated with the water management behaviour of farmers. Since the farmers are growing paddy for many years, the farmers scientifically did not know about why they should keep water level at different stages of crop growth .Farmers would like have more hills per plot in order to irregate other plots through same plot.Similar results were also obtained by Rao and Bora ,(1980) and Chandregowda (1996).

In respect of rice farming experience and its relationship with water management . The finding contradicted the findings of Bora, (1986), Nagaraja (1989) and Chandregowda (1996).

B. Sugarcane farming system:

Education, farm size, attitude towards sustainable agriculture and innovativeness have positive and significant relationship with water management behaviour of farmers in sugarcane farming(Table VIII).

Higher the education, higher the knowledge about sustainable practices. Higher the farm size, lesser the pressure on natural resources. In addition farmers favourable attitude towards sustainable farming might have facilitated to maintain sustained management of water. This finding is in line with the findings of Patel, et. al., (1994) and Chandre gowda (1996). Similarly, achievement motivation to reach targeted goals might have lead to better management efficiency in farmers as confirmed by Neil & Rogers (1963) and Chandregowda (1996). Extension system and research system link acts as catalystic force to promote sustainable agriculture, collecting bits of sustainable practices from different farmers etc, as approved by Van den Ban (1993), Patel et. al., (1994) and Chandregowda (1996). Hence, the above trend were observed among the sugarcane farmers.

5.3.4. Contribution of independent variables on water management .

A. Rice farming system:

A perusal of the Table IX indicates rice farming experience, rice farming intensity, innovativeness were negatively significant in contributing to the variation in the water management behaviour of rice farmers. All the 13 variables have succeeded in explaining

more than half of the variation (57.88%), in the nutrient management behaviour of rice farmers.

Even though, farmers having more of rice farming experience, farmers were following irrigation through single plot, due to small land holding and to have more rice crop to avoid wastage of land for irrigation purpose and hence the above trend might have occured . Thus farmers here were less concerned about sustainability of water management in rice farming . And also they were flooding the water in rainy season and do not mulch when there is shortage of water in the summer. This finding is contradictory with the findings of Chandregowda (1996).

B. Sugarcane farming system :

The Table IX, reveals that one variable , education out of 13 , was significantly contributed to the variation in the water management behaviour of sugarcane farmers.

It is a fact that, as education increases the knowledge of farmers increases regarding many aspects of package of practices. Thus farmers know more about ill effects of bad water management practices. Thus education contributed significantly in water management behaviour of sugarcane farmers. 13 variables on the whole have contributed significantly in explaining 55.51 per cent of variation in water management behaviour of farmers in sugarcane farming system. This finding is in line with the findings of Shilaja (1990) and Patel, et. al., (1994).

5.3.5. Relationship between Integrated Pest Management of sustainability and independent variables.

The results of relationship pattern between integrated pest management and independent variables are presented in the Table X.

A. Rice farming system :

Education, and farm size, economic motivation and research system link possessed significant relationship with integrated pest management behaviour of rice farmers .This indicates that farmer with higher education will seek more knowledge regarding problems of pest and diseases, and control measures to be used with the help of extension system link, considering his economy to control these problems hazards . Hence, positive significant relationship is observed between education and the IPM behaviour of rice growers. This findings is in inline with the findings of McClelland (1961), Lancini (1987), Saltiel et.al., (1994) and Chandregowda (1996).

B. Sugarcane farming system :

Age and rice farming experience were found to have negative significant relationship with the integrated pest management behaviour of sugarcane farmers.

The farmers of this area over the years might not have experienced the incidence of pest and diseases . Thus farmers were not motivated to have integrated pest management and to know about the same . This finding is in line with the findings of Gogoi and Gogoi (1989) and Dunlop. et. al. (1992).

Where as economic motivation had positive significant relationship with integrated pest management behaviour in sugarcane farming. Economic motivation is a character of entrepreneur who take normally risk (McClelland 1961) and this certainly motivates the farmers to be sustainable in sugarcane farming by practicing integrated pest management in sugarcane farming .

5.3.6 Contribution of independent variables on Integrated Pest Management.

A. Rice farming system :

As evident from Table XI, the sustainability of integrated pest management in rice farming system was influenced sigificantly by Rice farming experience but negatively . All the variable combinedly accounted for 40.21 per cent of variation in the integrated pest management behaviour which is found to be non- significant.

Thus even after having higher rice farming experience farmers resorted to chemical means to control the pests causing environment hazards and economical problem to the farmers. This finding is contradicting the finding of Chandregowda (1996).

B. Sugarcane farming system :

The persual of the Table XI reveals that all the 13 variables non-significantly contributed in explaining the variation of integrated pest management behaviour in sugarcane farming system. The possible reason might be that, almost all the sugarcane growers were not at all worrying about integrated pest management in sugarcane farming . 't was because there was no major pest and diseases accured in that area since many years . They were taking only few prophylactic measures rarely . Thus all the independent variables non significantly contributed to the integrated pest management behaviour of sustaianbility of sugarcane farming system.

5.3.7 Relationship between crop yield security of sustainability and independent variables.

The results of correlation of crop yield security of rice and sugarcane farming with independent variables are given in Table XII.

A. Rice farming system :

Farm size established highly significant relationship with crop yield security as perceived by farmers and all other 12 factors of farmer are found to be non significant with crop yield security of rice farming.

The probable reasons might be that, if farm size is larger , there will be less pressure on natural resources and also may get better yield due to sustained practices followed by farmer. And also larger area might have facilitated the farmers to practice rice based poly culture, this finding is in line with the findings of Rao, (198[illegible]) Bora & Ray (1986,) and Chandregowda (1996) .

B. Sugarcane farming system :

The relationship between independent and dependent variables showed that, farm size, family size , achievement motivation and innovativeness were having positive and significant relationship with the crop yield security behaviour of sugarcane farmers.

The plausible reason for this trend might be that if the family size is big, then they contribute to the sustainability of farming along with the risk bearing ability. Farmers with innovativeness and risk bearing ability always ponder over to get highest yield while maintaining sustainability. Thus, farmers with larger farm size, family size, higher achievement motivation and innovativeness will put less pleasure on land and other natural

resources by diversifying the crops in order to maintain the sustainability. The finding is inline with the findings of Gowda, (1991), Fitz simmons (1991), Patel , et.al., (1994) and Chandre gowda ,(1996).

5.3.8 Contribution of independent variables on crop yield security of rice and sugarcane farming system.

Rice and sugarcane farming system :

The results projected in Table XIII, reveal the influence of 13 independent factors on crop yield security of rice and sugarcane farming. All the factors in both rice and sugarcane farming were found to be non-significant in contributing to the variation in crop yield security of rice and sugarcane farming.

Crop yield security governed by many other factors which are not in human hand. It depends on incidence of pest and diseases, labour availability, inputs availability, water supply, natural calamities, etc. Therefore it depends upon one's own managerial ability. This might be the reason for establishing the non-significant relationship with all the independent variables.

5.3.9 Relationship between information self reliancy of sustainability and independent variables.

The results of the findings are explained in Table XIV.

A. Rice farming system :

Family size, achievement motivation, innovativeness, attitude towards sustainable agriculture and extension system link were positively and significantly related with information self reliancy of rice farmers.

Family members achievement motivation to reach the goal along with innovative character and supportive encouragement by extension personnel might have enhanced information self reliancy of farmers. The finding is reinforcing the findings of Gowda (1991), Beus and Dunlop (1994), Wasnik (1995) and Chandregowda (1996).

On the contrary education, farm size , rice farming experience, economic motivation, values related to agriculture and research system link were negatively and significantly correlated with the independent variables. The plausible reasons might be that farmers with higher education and economic motivation will naturally possess the character of seeking more information in order to get more production and profit in a short time. This finding is inline with the findings of Shilaja and Kalliyanpur (1984) and Dunlop, et.al., (1992). When the farm size is big , the farmers will try to have other crops in his field , to avoid risk, and hence he will try to seek information from different agencies.

Even though farmers were having good rice farming experience and research system contact , they find it difficult to control endemic pest and diseases and hence they might loose confidence by themselves. There by they might start asking others about good control measures. This might have contributed to the above trend. This finding is contradictory with the findings of Nagaraja (1989) and Chandregowda (1996).

B. Sugarcane farming system :

Of the 13 finding, only education of the farmers was found to be highly significant with the information self reliancy of farmers in sugarcane farming. The p usible reason might be that education mainly contributes and increses mental horizon including sustained practices of farmers . And there by farmers feel confident of their own ideas. This findings reinforces the findings of Nagaraja (1989), Shilaja (1990), Patel et. al., (1994) & Chandregowda, (1996).

5.3.10 Contribution of independent variables on information self reliancy.

A. Rice farming system :

The results projected in Table XV, reveals that family size, and attitude towards sustainable agriculture were significantly related to the information self sufficiency of rice farmers. Rice farming experience is negatively significant in contributing the variation in the information self reliancy of rice farming system. However, all the factors put together contribute to the extent of 60.91 per cent in the variation of information self reliancy behaviour of rice farmers.

It is fact that if family size is big and having favourable attitude towards sustainable agriculture, other members of the family also acquire information and contribute towards sustainability of information self reliancy. The finding is in line with the findings of Patel, et.al., Gogoi and Gogoi (1994) and Chandregowda (1996). On the contrary, the farmer with high achievement motivation will seek more and more information from others in

order to get better yield in rice farming. This findings contradicts the earlier findings of Chandregowda , (1996).

B. Sugarcane farming system :

A persual of Table XV, indicates that only one variable, education significantly contributed to the variation in the information self reliancy behaviour of sugarcane farmers. All the 13 variables contributed non-significantly to the extent of 29.76% to the variation in the information self reliancy of farmer.

Higher the education better will be the aquired knowledge and therefore educated farmers might have better knowledge of sustainability in sugarcane farming system . This finding is reinforced by the findings of Dunlop et.al., (1992) and Patel et. al., (1994).

5.3.11 Relationship between Input Self sufficiency of sustainability and independent variables.

Table XVI, clearly indicates the relationship of input self sufficiency with independent variables.

A. Rice farming system :

Family size, achievement motivation, innovativeness , attitude towards sustainable farming and extension system link established positive and significant relationship with input self sufficiency of rice farming system. If the family size is big, naturally it thrives for diversifying the enterpricess with sustainability. And also favourable attitude with higher achievement motivation, innovativeness provide synergic effects to have more owned inputs than borrowed . This finding confirmed the by findings of Gowda (1991), Saltiel, et.al., (1994).

On the contrary education , rice farming experience, economic motivation values related to agriculture and research system link negatively and significantly correlated with input self sufficiency in rice farming. The reason behind this might be the education together with economic motivation of farmer might have inspired the farmers to borrow more inputs from out side which may effect the sustainable production of rice farming . This is in accordance with the findings of Dunlop et.al., (1992) .

Rice farming experience and research system link were not positively related because farmers might not have known about how best to use their own resource to have higher input productivity due to lack of knowledge, technical feasibility etc. This finding contradicts the findings of Chandre gowda (1996) .

B. Sugarcane farming system :

In sugarcane farming system all the 13 independent variables established non-significant relationship with the input self sufficiency behaviour of sugarcane farmers . The main cause for this might be the influence of other extraneous variables and unavoidable circumstances.

5.3.12 Contribution of Independent variables on Input self sufficiency .

A. Rice farming system :

A glance at the Table XVII , indicates that none of the independent variables made significant contribution in explaining the varation of input self sufficiency behaviour of rice farmers. How ever 36.84 per cent of the variability is contributed by all the variables . There may be other variables which might probably contribute to the input self sufficiency of rice farmers .

B. Sugarcane farming system :

The Table XVII clearly indicates that only one variable economic motivation contributing significantly to the variation in the input self sufficiency of sugarcane farming system.

Due to more expenditure on labour and transportation, farmers were thinking that how best to use the resources they are having as a input for sugarcane farming. Thus they might have motivated to use more of crop residue to compost and there by reducing quantity of fertilizer and chemicals required. This finding reinforces the findings of Bora and Ray (1986), Nagaraju (1989),Shilaja (1990) and Chandre gowda (1996).

6.3.13 Relationship between Land Productivity of sustainability and independent variables.

Results in the Table XVIII shows relationship pattern between dependent and independent variables.

A. Rice farming system :

Attitude towards sustainable agriculture and achievement motivation possess significant relationship with the land productivity behaviour of farmers . The plausible reason may be the favourable attitude toward sustainable agriculture and the farmers wanted to achieve the target without affecting their natural resources. Thus, they were also aware the ill effects of chemicals and fertilizers from their past experience and this might have helped to maintain land productivity . This might be the possible reason for explaining the relationship between attitude towards sustainable agriculture and land productivity

behaviour of farmers. This finding reinforces the findings of Beus & Dunlop (1984), Saltiel, et.al., (1994) and Chandre gowda (1996).

But education, rice farming experience , economic motivation, values related to agriculture possessed negative significant relationship with land productivity of rice farmers. Farmers having higher education and economic motivation might use higher external inputs to get higher yield without considering the long term benefits and exploitation of natural resources. Even though they were having longer rice farming experience, they did not know about how to use chemicals and fertilizers in a safer way. This finding is in line with the findings of Bora (1986), Dunlop, et.al., (1992), Bray (1994) and Chandregowda (1996).

B. Sugarcane farming system :

In sugarcane farming system, education, family size, farm size, achievement motivation, innovativeness, extension system link established positive and significant relationship with land productivity . The motivated farmers will work for higher yield, and will seek consultancy with extension person and this might lead to understand more about sustainable practices with the help of farm and family size which consequently lead to have higher land productivity. The finding is in line with the findings of Gowda (1991), Patel et.al., (1994), Saltiel et.al., (1994), and Chandre gowda (1996).

5.3.14 Contribution of independent variables on land productivity of rice and sugarcane farming system .

As evident from Table XIX, that the sustainability of land productivity behaviour of rice and sugarcane farmers was not contributed significantly by any of the independent

variable. However, in sugarcane farming system, all the 13 variables combinedly accounted for 59.27 per cent of variation which is highly significant.

The land productivity of Bhadra command is found to be good even though farmer were not practicing all the sustainable practices in rice farming . Hence, many other variables might be contributing for sustainability of land productivity in rice farming system.

But in sugarcane farming system all the 13 variables combinedly influenced a lot due to human characters and tendency to have fertile land to get higher yields.

5.3.15 Relationship between Input Productivity of sustainability and independent variables.

Results in Table XX depicts the relationship between dependent and independent variables.

A. Rice farming system :

It is clear from TableXX that education, farm size, Rice farming experience, economic motivation, and research system link were established positively significant relationship with the input productivity of rice farming system .

As explained earlier , higher the farm size lesser the pressure on natural resources and experience and contact with extension personnel farmers can motivate the farmers to have sustained input productivity. This finding reinforced by the findings of Bora and Rao , (1989), Chandre gowda , (1996) . But attitude towards sustainable agriculture possessed negative and significant relationship with input productivity in rice farming . The plausible reason might be some unavoidable circumstance like, pest and diseases and dependency

on external inputs.Even though farmers were having favourable attitude, they were helpless to do sustained management practices to get increased input productivity. This finding contradicts the finding of Chandre gowda (1996).

B. Sugarcane farming system :

Education, family size, innovativeness, extension system link and research system link possessed positive and significant relationship with input productivity of sugarcane farming (Table XX).

Sugarcane is a commercial crop and therefore entrepreneurial risk of farmer require more education coupled with new things or ways to increase the productivity of input. For that research and extension system link acts as a catalyst to increase the productivity of inputs used for production in sugarcane farming . Hence, the above trend. The research finding is in line with the findings of Lancini (1987), Saltiel, et.al., (1994), Van den Ban (1992), and Chandregowda (1996).

But values related to agriculture, established negative and significant relationship with input productivity behaviour of farmers. As values related to agriculture is more, farmers may practice conventional practices which do not influence sustained input productivity , even though it is ecologically viable. This might be reason for the trend. This finding is in line with the finding of Chandre gowda (1996).

5.3.16 Contribution of independent variables on input productivity.

A. Rice farming system :

A persual of the Table XXI, indicates only innovativeness out of 13 variables contributed significantly to the variation in land productivity behaviour of rice farmers.

It is a fact that the innovative farmers are enthusiastic to add new ideas in their farm and how best to use inputs to produce more of out puts . Thus, the farmers have exploited inputs to extent possible so that they get better input productivity . This is confirmed by a study conducted by Chandre gowda (1996).

B. Sugarcane farming system.

The glance at the Table XXI, reveals that education contributed significantly and economic motivation and values related to agriculture contributed negatively , but significantly to the variations of the input productivity in sugarcane farming system. But all the factors together contributed significantly to the extent of 63.07% variations in the input productivity of sugarcane farming.

We already know higher the education better the sustainability in input productivity behaviour of sugarcane farmers. The educated farmers use inputs in a better way so that it will not damage the production enviornment . But, farmers with higher economic motivation and values related to agriculture are intended to have short term profits without knowing longterm ill effects . This finding is in line with the findings of Bora and Ray (1986), Nagaraja (1989), Shilaja (1990), and Chandre gowda (1996).

5.3.17 Relationship between Family Food self sufficiency of rice farming of sustainability and independent variables .

The results presented in Table XXII, revels that education, farm size , rice farming experience, economic motivation, research system link possessed positive and significant relationship with independent variable.

Farmers grow rice primarily to meet the need of the family. Therefore farmers keep rice primarily for their consumption and surplus will be sent to market . The findings are in

line with the findings of Nararaja (1989), Gogoi & Gogoi (1989), Bray (1994), Saltiel, et.al., (1994), and Chandre gowda (1996). Where as achievement motivation, innovativeness , attitude towards sustainable agriculture, and family size, established negative and significant relationship with family food self sufficiency of rice farmers. Higher the family size, lesser the food available for consumption if the family having small land holdings. Further, an innovative farmer will not normally bother about self sufficiency because , he can sell high value products that was produced and buy food grains required at cheaper rate and hence innovativeness and attitude towards sustainable agriculture are negatively and significantly related.

This finding contradicts the findings of Gowda (1991), Shilaja (19 0), Saltiel et. al., (1994), Beus and Dunlop (1994) and Chandre gowda (1996)

5.3.18 Contribution of Independent variables on family food sufficiency of rice farming system .

A glance at the Table XXIII, indicates farm size, rice farming intensity, innovativeness and economic motivation have made highly significant contribution in explaining the variations of family food sufficiency in rice farming system. All the variables together contributed 94.01% in predicting variation in family food sufficiency of rice farming system. Highly significant F value confirms the enormity of contribution.

It is a fact that farmers having innovative characters, with higher economic motivation with large size of land holding growing rice crop lead them to have more yield and farmers primary need is to have rice crop to meet the food requirements of family members . Higher and more yield lead to have sufficient grains for family members and thus it contributes to family food sufficiency in rice farming and thus. Innovativeness and

economic motivation contributed positively and this confirms with the finding of Chandre gowda (1996). Rice farming intensity correlated negatively and therefore contradicts the finding of Chandre gowda (1996).

5.3.19 Relationship between Ratoon Management of sustainability of sugarcane farming and independent variables.

Table XXIV indicates that, the relationship between extension systems link, farm size, achievement motivation, innovativeness, research system link and ratoon management of sugarcane farming are found to be significant. This clearly denotes that higher the farm size, better the management of natural resources. Farmers motivation to get sustained yield make them to learn new ways to manage the ratoon crop with the help of extension and research system link for 3-5 times which was evidenced from investigation .

The finding is in line with the finding of Beus & Dunlop (1994), Saltiel et. al., (1994), Patel, et.al., (1994) and Chandre gowda (1996).

But values related to agriculture established negative significant relationship with ratoon management behaviour of farmers which infers that farmers will have to take timely operations to get a good ratoon crops. This finding reinforces the findings of Chandre gowda (1996).

5.3.20 Contribution of independent variables on Ratoon management of sugarcane farming system.

The persual of the Table XXV, projects that only farm size contributed siginificantly in explaining the variation of ratoon management behaviour of sugarcane farmers . However, all variables put together explained the variation significantly to the extent of 44.61 per cent.

As the farm size increases there will be lesser pressure on natural resources and management practices will be practiced with out effecting the production environment . And also the trash available from the sugarcane can be used as compost as a mulch for other crops viz., Arecanut, Coconut, etc. These might be the reasons for observing the above trend. This finding is in line with the findings of Shilaja (1990), and Patel, et.al., (1994).

5.4 Reasons for low sustainability in Rice and Sugarcane farming system.

The following discussion is in relation with reasons for low sustainability and they are presented in Table XXVI.

Rice farming system :

The problem hindering the sustainability of rice farming is the poor nutrient management as perceived by farmers . Most of the farmers did not test the soil. Among several other things, lesser application of organic manure due to decline in the availability of organic manure, imbalanced and excess use of inorganic fertilizer, neglect of micro nutrient and soil amendments have been the major cause of the situation.

Organic manure even when applied, could not applied well before transplanting because there is no sufficient time gap between first and successive crop. And also in rice based cropping system , crop rotation was not done oftenly. To overcome this problem, farmers are using excess inorganic fertilizer, and this results in more damage to production environment than the benifit .This apart, need for micronutrients and soil amendments has not been felt by the farmers who think of always only NPK for getting good crop. But farmers even though they are aware of importance of green manure, many are not growing

in field or brought it from out side because of small land holding and high labour wages. And so also about the bio-fertilizers. Interstingly farmers are not aware of where exactly Bio- fertilizer are available .

The situation is still warst in water management . Many farmers failed to understand the advantages of maintaining water level required at different stages of crop growth. In summer there is always water scarcity, so the farmers are leaving crop to dry in critical stages of crop growth and some others were using bore well water to maintain their crop.

The measures taken in respect of integrated pest management was l ;tter . It was due to offenly accuring pest & diseases . The farmers resorted to integrated management practices , because farmers were realised that chemicals are not so effective to control some pests in that area.

Along with these, higher labour wages, high rate of chemicals and fertilizers, lower extension contact , higher cosmopoliteness etc. were also contributed for medium level of sustainability in rice farming.

Sugarcane farming system :

The farmers are more interested in growing sugarcane as commercial crop by using more inputs to get higher yield. They are also borrowing and applying FYM and grow leguminous crops after harvesting third or fourth sugarcane crop. This requires more labour and also more expensive. This has lead to low input self sufficiency in sugarcane farming. Further more, 2-6 months delay in marketing the cane reduced the yield of sugarcane crop. And also extension personnel failed to give proper guidance in this regard .

Reliancy on inorganic fertilizers and hired labour to perform most operation has resulted in low input self sufficiency .All the factors mentioned above contributed for medium level of sustainability of sugarcane farming system.

Summary

VI SUMMARY

The primary aim of agricultural development programme of 1960's and 1970's was to increase production of food grains leading eradication of hunger. The need based research and extension have played a crucial role in this direction particularly to increase the production of certain crops. Crops given importance were Rice and Sugarcane among many. As farmers have encouraged to concentrate on monoculture, their dependency on external inputs too has increased alarmingly. In the process, the negative environmental and social inputs have become increasingly evident, even among small production systems. But the repeated cultivation of these crops with larger use of external inputs has created economic insufficiency and ecological imbalance. This has made planners and policy makers to look for alternative approaches for the greater benefit of mankind.

Realising the dangerous to the existence of mankind, scientists and planners started advocating agricultural packages which do not affect the ecology and environment. This has lead to ultimately for the formation of sustainable agricultural development. Now, many of scientists and extension workers are giving lot of importance to agricultural packages which are sustainable. There fore it has become essential to study the sustainable practices being followed by farmers in two different farming system.

Keeping all these things in view, this study was designed with the following specific objectives.

1. To find out sustainabiliy level of rice and sugarcane farming system.

2. To assess and compare the performance of indicators of sustainability of rice and sugarcane farming system.
3. To find out relationship between independent variable and their contribution with indicators of sustainability of rice and sugarcane farming system.
4. To find out reasons for low sustainability in both rice and sugarcane farming system.

Sustainable components identified by Chandre gowda (1990) were taken for sustainability of rice farming system. Rigorous and scientific procedures were used to find out components of sustainability of sugarcane farming system and to construct interview schedule. To select 50 respondents for each farming system, simple random techniques were used. Personal interview and discussion with respondents and their family members was instrumental in obtaining all the details required for the study. The data were scored, tabulated and analysed keeping in view the objectives of this study. Important findings are summarised below.

Findings :

Sustainability of rice and sugarcane is a composite of nine components or indicators belonging to ecological, economic and social dimensions. The overall sustainability level of each system, and their components with comparison are presented below.

1. Both the farming system are moderately sustainable in Bhadra command area of Shimoga district .

2. Sustainability of sugarcane farming was found better than sustainability of rice farming system.

3. Ecologically and economically, sugarcane farming system was found more safer and better than rice farming system .

4. The level of nutrient management among farmers differed significantly from sugarcane farming to rice farming system.

5. Water management was generally poor in rice farming system compared to sugarcane farming system.

6. Integrated pest management was medium in rice farming and poor in sugarcane farming. But in rice farming system, farmers were worried to control the deadly pest and diseases which are frequently accuring.

7. Ratoon management among farmers in sugarcane farming was better .

8. The rice farming farmers faced the more uncertainty in getting expected yields than sugarcane farming system. Farmers of rice farming on an average, obtained 20 percent lesser yields than the expected yield level. And sugarcane farmers were getting 15.5% less than expected yield.

9. There was lot of variation in the level of input productivity of rice farming system. Average B:C ratio inrespect of rice and sugarcane were 1.84 and 3.13 respectively.

10. Mean values of land productivity of rice and sugarcane farming system indicated that land productivity of sustainability was better.

11. Sugarcane farmers exhibited better information self reliancy than rice growing farmers.

12. Input self sufficiency of rice farming differs singnificantly with sugarcane farming system with the average percentage of 44.24 and 29.84 input self sufficiency respectively.

13. Of the thirteen factors studied, only farm size was positively and singificantly related to rice nutrient management behaviour of rice farmers. Further all the thirteen factors failed to predict the variation in the nutrient management behaviour of farmers.

Education, farm size, innovativeness , attitude towards sustainable agriculture, extension system link and research system link were found to be significantly related to nutrient management behaviour of sugarcane farmers. Where as values related to agriculture was negatively and significantly correlated with nutrient management behaviour of sugarcane farmers .

Farming intensity and education level of farmers have explained the variation significantly in nutrient management behaviour of sugarcane farmers.

14. The variables viz., family size, achievement motivation, attitude towards sustainable agriculture were found to be significantly related to water management behaviour of sugarcane farmers. Farming experience , rice farming intensity and innovativenes has explained negatively but significantly in the variation of water management behaviour of the rice farmers variables like education, farm size, attitude towards sustainable agriculture, innovativeness, and extension system link had positive relationship with the water management level of sugarcane farmers. Whereas values related to agriculture depicted negative relationship with water management level of sugarcane farmers . Further education level of farmers has explained the variation significantly in the water management behaviour of sugarcane farmer.

15. Education, farm size, economic motivation and research system link estabilished the positive relationship with the intergrated pest management level of rice farmers. Further rice farming experience of farmers negatively contributed in explaining the variation.

Regarding relationship between integrated pest management level of sugarcane growers and independent variables, age and sugarcane farming experience revealed negative relationship, where as economic motivation estabilished positive relationship.

16. Variable farm size had positive relationship with crop yield security behaviour of rice farmers.

In case of sugarcane growers farm size, family size, achievement motivation and innovativeness were found to have significant relationship with crop yield security behaviour.

17. The variables like family size, achievement motivation, innovativeness, attitude towards sustainable agriculture and extension system link had positive relationship with the information self reliancy behaviour of rice farmers. Further family size and farm attitude towards sustainable farming contributed positively and farming experience contributed negatively in explaining the variation in information self relaiancy of rice farmers.

The variable education showed significant relationship with information self reliancy behaviour of sugarcane farmer and it also contributed significantly in explaining the variation in information self reliancy behaviour of sugarcane farmers.

18. In case of rice farmers, family size, achievement motivation, innovativeness, attitude towards sustainable farming, and extension system link revealed positive relationship with the input self sufficiency behaviour . Where as education , rice farming experience, economic motivation research system link showed negative relationship with input self sufficiency behaviour of rice farmers. But t is interesting to note that none of the variable have explained significant variation in input self sufficiency behaviour of rice farmers.

Economic motivation of sugarcane farmers has explained the variation significantly in the input self sufficiency level of sugarcane farmers.

19. Correlation co-efficient in respect of attitude towards sustainable farming, achievement motivation showed have positive, and significant relationship with the land productivity of rice farmers . Where as education , farming experience, economic motivation, values related to agriculture and research system link demonstrate negative relationship with the land productivity behaviour of rice farmers.

Variables like education, farm size, achievement motivation, innovativeness and extension system link had positive relationship with the land productivity behaviour . Where as values related to agriculture, research system link revealed negative relationship with the land productivity behaviour of sugarcane farmers.

20. Variables like education, farm size, economic motivation, research system link and rice farming experience had significant and positive relationship with the input productivity behaviour of rice farmers. Where as attitude towards sustainable agriculture showed negative significant relationship with the input productivity behaviour of rice farmers. Further innovativeness of rice farmers has explained significant the variation in input productivity behaviour of rice farmers.

The variables such, as, Education, family size, innovativeness , extension system link, attitude towards sustainable farming, research system link of sugarcane farmers showed positive and significant relationship with the input productivity behaviour . Where as values related to agriculture showed negative relationship. Further, education contributed positively and economic motivation and values related to agriculture, contributed negatively in explaining variation in input productivity behaviour of sugarcane farmers.

21. The variables like education, rice farming experience, economic motivation and research system link had positive significant relationship with the family food sufficiency behaviour of rice farmers. Where as achievement motivation, attitude towards sustainable agriculture and family size showed negative but significant relationship with the family food sufficiency of rice farmers. Further, farm size, rice farming intensity, innovativeness and economic motivation have explained the variation significantly in family food sufficiency behaviour of rice farmers.

22. In case of sugarcane farmers, farm size, extension system link, research system link, achievement motivation and innovativeness had positive and significant relationship with the ratoon management behaviour . Where as, values related to agriculture possessed negative relationship with ratoon management behaviour. Further, farm size of sugarcane farmers has explained the variation significantly in the ratoon management behaviour of sugarcane farmers.

23. Both the farming systems possessed inherent and man made problems that have come in the way of sustainable farming. Most of the problems are man made and are dominated by ecologically unsafe practice like inadequate use of organic manure, non-application of micronutrients and soil amendments , excess or imbalanced use of inorganic fertilizers, improper management and dependency on chemicals to combat pest and diseases, dependency on purchased inputs, and non availability of labour have further reduced the sustainability level of rice farming in an irrigated area.

The above problems do existed in sugarcane farming except water management and chemical used to combact pest and diseases, marketing the cane at right time and also the prices contributed for the medium level of sustainability in this farming system.

Implications :

The findings of the study have the following implications for field extension work.

1. Rice farming is only moderately sustainable in Karnataka (Chandre gowda, 1996). This study also in revealed that both rice and sugarcane farming system are moderately sustaianble. The state can not afford to have this situation to continue any more considering the value and need for its increased production to feed ever increasing population.

The rice farming system is economically viable and socially stable but ecologically unsafe . Ecological safetyness of this system can be improved if farmers give more consideration to organic farming, judicious water management and cultural , mechanical measures to fight pests. Inadequate application of organic manure is primarily because of limited livestock population. Availability of paddy straw should solve the problem of animal feed even in the absence of grazing land . Effective utilisation of bunds by growing fodder and green manure trees will supplement both fodder requirement for livestock as well as green manure requirement of the fields. This practice also useful in sugarcane farming system.

Effective planning of crop rotation , preferably a short duration pulse or green manure crop would be a boon for interior fields . Farmers need to be taught on the usefulness of composting by utilizing sugarcane crop residue and locally available material to a maximum extent instead burning it . Use of bio-fertilizers in both rice and sugarcane field should be given top priority and their culture should be made available within the reach of farmers at the right time of use.

It is responsibility of research system to provide strong technical support to improve overall sustainability of both rice and sugarcane farming system.

The extension field functionaries should educate and train the farmers about the method and time of application of fertilizers, proper water and integrated pest management . And also should educate the farmers regarding ill effects of imbalance and indiscriminate use of chemicals and fertilizers. Their crude faith on inorganic fertilizers and the fallacy of the understanding that 'more the fertilizers' , 'better the yield', should be removed from the farmers mind at any cost.

There is a need of alternative packages particularly in the form of suitable varieties for different seasons. To solve marketing problem of the sugarcane crop by the sugarcane growers. Higher economic motivation, achievement motivation and favourable attitude towards sustainable farming with higher education can be utilised by the extension personnel to the maximum extent to increase the sustainability level in both rice and sugarcane farming system .

As on now, sustainable agriculture practices are available only in bits . There is a greater need to develop sustainable practices as package for the both farming system. Effective linkage between research ,extension and farmers systems should help in identifying problems , causes and ultimately arriving at the most appropriate solutions through onfarm research and onfarm trials . These solutions are expected to be ecologically safe, economically viable ,socially just and hence sustainable.

Suggestions for future research :

The following suggestions are made for the use of future researchers who undertake studies related to sustaianbility.

1. There is a need to standardise the indicators of sustainability in sugarcane farming system. Also , there is need to identify indicators for all the cropping system in our state.

2. Zone wise research study on the sustaianbility of different cropping system can be taken up to find out the sustainbility level , and this inturn will immensely help the researcher to come out suitable sustainable packages .

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Appendices

APPENDIX I

UNIVERSITY OF AGRICULTURAL SCIENCES : BANGALORE

Dr. N.R. Gangadharappa
Assoc. Professor

Dept. of Agril. Extension
Agricultural College
Hebbal, Bangalore -24
Date : 16 - 7 - 96

Dear Sir,

I am glad to inform that Sri Nagendra Rao Y., a Senior M.Sc. student of Agril. Extension is pursuing a research study entitled "Comparative analysis of rice farming system with sugarcane farming system" under my guidance. As part of study, the student is trying to develop an index to measure sugarcane sustainability of sugarcane farming.

In this connection of some components of sugarcane farming system have been listed in due annexure based on review of literature and discussion with a few experts. Considering your higher academic qualification and rich experience, we are pleased to seek your valuable judgement on the relevancy of these components to sustainability of sugarcane farmers. The definitions of each of the components are also provided along with the operational definition of sustainability
of sugarcane farming to facilitate your judgement.

Please make specific judgement on the relevancy of the components on four points continuum, by ticking (√) in the appropriate column. Your are also requested to suggest any other pertinent item(s) that your consider as relevant to sustainability of sugarcane farming.

I, therefore, request you to kindly spare some of your valuable time and help in the research. The filled in proforma may please be mailed back to the research in the enclosed envelope.

With kind regards,

Yours sincerely,

(N.R. Gangadharappa).
Associate Proffessor
Division of Agril. Extn. Edn.
College of agriculture (UAS)
GKVK. Bangalore- 65.

ANNEXURE

Sustainability of Sugarcane Farming :

Sustainability of Sugarcane farming has been operationalised as the process by which a farmer manages soil and water relying mainly on farm resources ie., the use of no cash and low cash inputs technologies and minimising the use of chemicals to enhance productivity without affecting production environment.

SL. No.	Indicators of Sustainable Sugarcane Farming	Relevancy			
		VMR (1)	R (2)	S. W. R. (3)	N. R. (4)
1a.	Nutrient Management : (Application of right quantity of organic and in organic fertilizer and amendments to soil at a proper time, method and combination aimed at deriving maximum benefits and causing minimum damage to the resource base).				
2.	Integrated Pest Management : (Management of pest (insects, disease and weeds) by using preventive measure, through judicious combination of cultural, mechanical biological and chemical measures).				
3.	Water Management: (Application of practices to obtain added benefits from rainfall and water from through irrigation for crop production with a proper drainage to keep the soil health intact).				
4.	Crop Yield Security : (Extent to which farmer manages to get expected yield inspite of external crisis situation).				
5.	Information Self Reliancy : (Ability of the farmer to posses information for successful sugarcane farming and rely upon that at the time of decision making).				
6.	Input Self Sufficiency: (Extent to which farmer needs input requirement of sugarcane farming from own resources then purchased inputs).				
7.	Family Food Self Sufficiency : (Extent to which a farmers family possessed sufficient sugarcane for family consumption).				
8.	Land Productivity : (The output per unit area)				
9.	Input Productivity : Output / Input If any to be added , please specified.				

VMR = Very Much Relevant, SWR = Some what Relevant,
R = Relevant, N.R = Not Relevant.

APPENDIX II

UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

DATED : 8/10/1996

TO

The Assistant Director of Agriculture,
Department of Agriculture,
Bhadravathi Taluk,

Dear Sir,

I am glad to inform that Sri. Nagendra Rao, Y., a Senior M.Sc., student of Agricultural Extension is a pursuing research study entitled "Comparative analysis of sustainability of Rice and Sugarcane farming system". In this connection, I request you to kindly spare some of your valuable time to select the villages having higher RFI & SFI for conducting research in scientific way.

Thanking your,

Yours sincerely,

(N. R. GANGADHARAPPA)
Associate Proffessor
Division of Agril. Extn. Edn.
College of Agriculture (UAS)
GKVK ., Bangalore - 65.

APPENDIX III

INTERVIEW SCHEDULE
PART I

1. Name of the farmer :
   Village : ---------- Taluk : ----------

2. Age and education status of family members :

Sl. No.	Name	Age	Education
a.			
b.			
c.			
d.			
e.			
f.			
g.			

3. Details of land holding :

Nature of land	Land owned	land leased in	land leased out	Total
Wet land				
Graden land				
Dry land				
Total :				

4. Details of crops grown in the year 95-96 :

Crops	Area under cultivation			Total (ha)
	Kharif	Rabi	Summer	
I.	100%			
ii.				
iii.				
iv.				
v.				
vi.				
Total :				

5. Since how many years you have been cultivating

6. Achievement motivation :

(a) Any farmer with ability and willingness to work hard has a good chance of success

Agree / Disagree

If Agree,

(b) Do you think that you have succeeded as a farmer because of your hard work ?

Yes / No

(c) Will you work still hard in future also to become a successful farmer ?

Yes / No

ii)

a). A farmer should use all his efforts in reaping a good harvest.

Agree / Disagree

If agree,

b) Do you think that your had used all your efforts to get high yields from your crop?

Yes / No

c) Don't you feel that you can get higher yields even if you do not much efforts in raising crop ?

Yes / No

iii) a. A farmer should utilise the available resources to boost his level of production

Agree / Disagree

If agree,

b) Do you think that you are utilising your land in the most efficient manner by adopting practices ?

Yes / No

c) Will you try to raise more crops from the same piece of land you have ?

Yes / No

iv) a. A farmer should plan to harvest higher yields and try to attain them.

Agree / Disagree

If agree,

b) Did you prepare any cropping plan for your land during the last year ?

Yes / No

c) Are you trying to increase the yield of your crops year after year?

Yes / No

v) a. One should feel that he can achieve the things he wishes

Agree / Disagree

If agree,

b) Do you think that have more or less succeeded in achieving all the things you wished ?

Yes / No

c) Do you feel that you can definitely achieve all the things you wish in the future also ?

Yes / No

vi) a. A farmer should feel that no obstacle can stop him from reaping a harvest.

Agree/ Disagree

b) Don't you think credit is a problem for you to purchase the inputs ?

Yes / No

c) Don't you think that pests and diseases will reduce the yields from your crops?

Yes / No

vii) a. One can really take a pride if he does hid job well.

Agree / Disagree

If agree,

b) Do you think that farmers can also be proud of their profession?

Yes / No

c) Have you ever felt dissatisfied being a farmer ?

Yes / No

viii) a. One should have to keep learning new skills for better management of the farm

Agree / Disagree

If agree,

b) Have you participated in any training programme for the farmers?

Yes / No

c) Do you want to participate in training programme for the farmers in future also ?

Yes / No

ix) a. One should take part in competitions and try to perform better than others.

Agree / Disagree

If agree,

b) Have you participated in any crop competitions conducted in your area ?

Yes / No

c) Will you avoid participating from crop competitions to be conducted in your area ?

Yes / No

x) a. One must provide good education to all his children.

Agree / Disagree

If agree,

b) Won't you discourage your children from studying more and more ?

Yes / No

c) Do you want your children to attain higher educational status ?

Yes / No

7. INNOVATIVENESS :

Here are eight statements. You may please go through each statement and indicate your response.

Statement	Response		
	Yes	Undecided	No
a) Do you want to learn new ways to farm ?			
b) If the agricultural extension worker gives a talk on improved cultivation aspects, would you attend?			
c) If the Government would help you establish a farm elsewhere, would you move ?			
d) Do you want a change in your way of life ?			
e) A farmer should try to farm the way his parents did			

f) Do you want your sons to be farmers ?

g) It is better to enjoy today and let tomorrow take care of itself

h) A man's fortune is in the hands of God

Economic Motivation : Indicate whether you AGREE or DISAGREE with the following statements:

8. ECONOMIC MOTIVATION : Indicate whether you AGREE OR DISAGREE with the following statements :

Statements	Response	
	Agree	Disagree
1. A farmer should work towards large yields and economic profits		
2. The most successful farmer is one who makes the most profit		
3. A farmer should try any new farming idea which may earn him more money		
4. A farmer should grow cash crops to increase monetary profits in comparison to growing of food corps for home consumption.		
5. It is difficult for the farmers' children to make good start unless he provides him with economic assistance.		
6. A farmer must earn his living, but the most important thing cannot be defined in economic terms		

9. ATTITUDE TOWARDS SUSTAINABLE FARMING :

Statements	Response categories				
	SA	A	N	DA	SD
1. Rice / Sugarcane farming should be done so as to maximise profits even if it threatens long term productivity of land.					
2. Large quantity of inputs should be used in rice/ sugarcane farming as long as it is profitable.					
3. The primary goal of farmers should be to improve quality of the products produced in their farms.					
4. Good rice farming demands personal experience and better knowledge of the land.					
5. Agricultural Scientists and policy makers should recognise that there are limitations to what nature can provide and adjust their expectations accordingly.					

6. Health, rural communities are essential to make the rice farming a success.
7. Farm traditions and culture are of little use in modern rice farming.
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 of Production.
10. Most farmers should specialise either in livestock or crops.
11. Modern farming is a major cause of ecological problems and must be greatly modified to become ecological sound.
12. Crop rotations and diversifications are not essential for successful farming.
13. Farmers should produce as many of their own goods and services.
14. Soil and water are basic factors of production and should be exploited for larger production.
15. The key to initiate successful farming lies in learning to imitate natural ecosystem 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 farm as much land as they personally care for.
19. Most people should live in cities of struggling all through life in farming.
20. The abundance of the production is an indicator of correct way of farming.

SA : Strongly Agree; A : Agree , N : Neutral D : Disagree SD : Strongly disagree.

10. EXTENSION SYSTEM LINK :
a) Extension personnel contact :

	Once in a week	Once in a f . n	Once in a month	Once in a while	Never
a. A. A.					
b. A.A. O.					
c. A. H. O.					
d. H. A.					
e. Livestock Inspector					
f. Veterinary Doctor					
g. Dairy Extension Officer					
h. B. D. O.					
i. Devt. Asst. Officer					
j. Forester					
k. Forest					
l. Any other					

b) Participation in Extension Methods :

Methods	Once a week	Once in fortnight	Once in month	Once in a while	Never
a. Demonstrations					
b. Krishimela					
c. Training					
d. Field days					
e. Field visits					
f. Educational tours					

11. RESEARCH SYSTEM LINK :

Activities	Numbers
1. Correspondence with the research Orgnanization or with scientists directly	
2. Visit to the research station for a specific purpose.	
3. Visit of scientists to the farmers field	
4. Attended / Participated in Exhibition / Workshop/ Seminar/ Field day organised at research stations.	
5. Taken up adaptive trial, front - line demonstration etc.	

12. VALUES RELATED TO AGRICULTURE :

State whether you ' Agree' or 'Disagree' with the following statements :

Statement	Response Agree	Disagree
1. God's blessing is the most important condition necessary for a good crop.		
2. A farmer should not be sentimental in selling away old cattle.		
3. It is below the dignity of a person of good social standing to engage in activities such as raising poultry even though they can be profitable.		
4. It is below the status of a woman belonging to a respectful family to work as labourer in another man's farm.		
5. As pig is a dirty animal, a person belonging to a higher caste should not rear it.		
6. In cultivating different crops, one's attempt should be to meet the requirements of one's family.		
7. Only those persons whose occupation by tradition is the keeping of animals would succeed in dairy.		

8. It is below the dignity of an educated youth to plough fields.
9. One should try to start important agricultural works during auspicious periods.
10. It is due to the displeasure of God on human beings that it does not rain regularly on some occasion.

RICE

PART - II

Please give the following details regarding the rice or sugar crop grown in the year 1994-95.

Sl. No.	Variety / ies cultivated	Area (ha)	Time of sowing
1.			
2.			
3.			
4.			
5.			

I. NUTRIENT MANAGEMENT

Have you tested your rice plots for nutrient status ? Yes / No

A. MANURIAL MANAGEMENT :

1. Did you apply FYM / Compost to rice plots ? Yes / No
   If yes, what was the quantity ?
   for monsoon crop ---------- tons / bullock card loads
   for rabi / summer crop ---------- -do-

2. When the FYM / Compost was applied ?
   ---------- days before transplanting

3. How the FYM / Compost was applied ?
   ----- mixed into soil followed by pudding
   ------ spread on the surface of soil

4. Did you incorporate green manure to rice plots 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 transplanting

6. If the green manure was applied externally, what was the quantity ?
   -------- tons.

7. Did you apply the available FYM 1/4 compost/green manure to all the plots ? Yes / No.

8. Did you incorporate azolla to the plots ?
If yes, what was the area under azolla nursery ?
———————— sq.mts.

9. Did you incorporate azolla to all the plots ? Yes / No
If yes, did you reduce N dosage accordingly ? Yes / No

10. Did you mix any crop residue to rice plots ? Yes / No

8. FERTILIZER MANAGEMENT :

1. Did you apply fertilizers to the rice plots ? Yes / No
If yes, give details of the nature and quantity of fertilizers and time of application.

Nature of fertilizer	Base dose		Top dressing	
	Quantity	Time	Quantity	Time
1.				
2.				
3.				
4.				
5.				

2. How the basal dose was applied ?
- mixed into soil at the time of last ploughing
- applied on the surface of soil
- applied on standing water in the field

3. Did you treat the fertilizer at the time of top dressing? Yes / No

4. Could you meet the full fertilizer requirement all the plots?
If no, the available fertilizer was
- equally distributed to all the plots
- applied to all plots but unequally.
- applied to some plots and not applied to other plots.

5. Does your soil has zinc deficiency ? Yes / No
If yes, did you apply zinc sulphate? Yes / No
If yes, when did you apply ?

- at the time of transplanting
- into the soil at a later date
- in the form of foliar spray

6. Does your soil has silicon or iron deficiency ? Yes / No
If yes, have you taken up amendment measures? Yes / No

7. Does your rice fields are salt affected ? Yes / No
   If yes,

   a) Did you apply required level of gypsum to soil ? Yes / No
   - a week earlier to transplanting
   - at the time of transplanting
   - during crop growth period

   b) What was the quantity applied ? ---------- kg/ha.

8. Is your soil acidic in nature ? Yes / No
   If yes, did you apply calcium to soil ? Yes / No
   was it applied as per the recommendation ? Yes / No

II. WATER MANAGEMENT

1.	Have you kept your rice plots perfectly levelled ?	Yes/ No 3/0
2.	Did you puddle or prepare the lands properly before transplanting ?	Yes/No 3/0
3.	Did you maintain adequate moisture in the field after mixing organic manure?	Yes/No 3/0
4.	Did you drain off the water before applying basal dose of fertilizer?	Yes/No 2/0
5.	Did you drain off the excess water at the time of top dressing?	Yes/No 2/0
6.	Did you stop flow of water from plot to plot after applying fertilizers?	Yes/No 2/0

7. What was the level of water in the rice field during the flowing stages of crop growth ?

a) During the initial 10 days :

i. No standing water and cracks appeared	
ii. a thin layer of water maintained	2
iii. more than 3cm of standing water	0

b) During tillering stage

i. no standing water and cracks appeared	0
ii. upto 3 cm of water maintained	2
iii. more than 3 cm of standing water	0

c) During flowering stage

i. no standing water	0
ii. upto 5 cm of water maintained	2
iii. more than 5 cm of water maintained	0

d) During grain filling stage

i. no standing water	0
ii. water level of 5 cm was maintained	2
iii. more than 5 cm of water was allowed	0

e) During the last 10 days of crop growth

i. allowed to gradually dry up	0
ii. water completely drained off at once	2
iii. standing water was allowed	0

8. In case of irrigated rice :

i. irrigation to all the plots was done through a single plot	0
ii. each plot was irrigated through separate water inlets	2

9. In case of rainfed rice, have you practiced the following water management practices ?

i. mulching of any kind like crop mulching, solid mulching to conserve moisture at water shortage time	Yes / No
ii. strengthened bunds to restrict water seepage	Yes/ No
iii. provided diversion drains at the time of overflowing	

10. Is your soil salt affected ? If yes, Yes/No

i. have you opened drains to drain out the excess water ?	Yes/No
ii. changed the salt affected water and allowed fresh water frequently.	

III. INTEGRATED PEST MANAGEMENT

A. Prophylactic measures :

Did you practice any of the prophylactic practices owing the corps?

a. fall ploughing : Fully / Partially / No	
b. correct time sowing for chosen variety	2 1 0
c. Right variety for the time you were able to sow	
d. Seed treatment	
e. Precautionary sprays at nursery	
f. Crop rotation with legume or green manure crop	

B. Curative measures :

1. Mention the insects appeared during the crop growth period and the nature of control measures practiced if any during the previous year.

	Nature of insects	Control measures
a.		
b.		
c.		
d.		

2. Which diseases were found on rice crop during the year 1994 - 95? What were the control measures practiced ?

	Nature of disease	Control measures adopted
a.		
b.		
c.		
d.		

3. What kind of weeds appeared in your rice fields during the previous year?

	Name of the weed	Control measures adopted
a.		
b.		
c.		
d.		

IV. SUSCEPTIBILITY TO EXTRANEOUS FACTORS :

Could you please recall the extent of loss your crop suffered due to the following reasons :

	Reasons	Yield loss (Qtls.) Kharif	Rabi	Summer
a.	Attack of pests and diseases			
b.	Failure of rainfall / water supply			
c.	Excess rainfall / floods			
d.	Non-availability of inputs			
e.	Labour shortage			
f.	Total yield loss (a+b+c+d+e)			
g.	How much yield did you get ?			
h.	Expected yield (f+g)			

V. INFORMATION SELF RELIANCY :

Mention the extent of dependency for information on the following areas on yourself and others.

Information areas	Source of information			
	Completely self	Partly and	Completely other	partly others
1. Time of nursery raising				
2. Area under nursery				
3. Nursery management				
4. Seed rate				
5. Seed treatment				
6. Variety / ies				
7. Organic manuring				
8. Plant density				
9. Time of fertilizer application				
10. Nature of fertilizers				
11. Quantity of fertilizers				
12, Method of application				
13. Identification of nutrient deficiencies				
14. Amending deficiencies				
15. Identifying insects				
16. Controlling insects				
17. Identifying diseases				
18. Controlling diseases				
19. Weed controlling				
20. Water management				
21. Time of top dressing				
22. Fertilizer treatment				
23. Tillage and cultural equipments.				

VI. INPUT SELF SUFFICIENCY :

Give details about the quantity of inputs used, value of those inputs and the sources from where they were obtained.

Inputs used	Own sources		Puchased	
	Quantity	Value	Quantity	Value
1. Seeds				
2. FYM/compost				
3. Green manure				
4. Fertilizers				
5. Chemicals				
6. Human labour				
7. Animal labour				

8. Equipments
9. Others, if any
10.

Total : _____

VII. LAND PRODUCTIVITY

Could you please recall the total quantity of rice produced on your farm from the past three corps.

Crops	Area under sugarcane	Total quantity of rice produced
1. Previous crop		
2. Second previous crop		
3. Third previous crop		
Total :		

$$LP = \frac{\text{Total quantity of rice produced from the three corps}}{\text{Total area under rice during the past three crops}}$$

VIII. INPUT PRODUCTIVITY

---

a. i. Total quantity of rice produced during the year 1994 - 95
   ii. Value of the total produce — Rs. ----------
b. i. Total quantity of straw produced — Tons ----------
   ii. Value of the total straw — Rs. ----------
c. What was the total cost of production (as given in input sufficiency) — Rs. ----------

$$P = \frac{\text{Value of total output (a+b)}}{\text{Total cost of production}}$$

IX . FAMILY FOOD SUFFICIENCY

Please give details of the rice produced and consumed by your family members :

a. Total quantity of rice produced on your farm during 1993 -94. :

b. Quantity of rice given to labour as wages (if any) :

c. Quantity of rice returned, if you had borrowed from others earlier :

d. Quantity of rice that available for your family consumption :

e. Quantity of rice require for consumption for your family for one fiel year :

$$FFS = \frac{d}{e} = \frac{[a - (b + c)]}{e}$$

SUGARCANE

PART - III

Please give the following details regarding the Sugarcane crop gown in the year 1994 - 95.

Sl. No.	Variety / ies cultivated	Area (ha)	Time of sowing	Productivity t / ha

---

1. NUTRIENT MANAGEMENT

Have tested your sugarcane plots for nutrient status Yes / No
If yes, in which year ---------- and what is the status

A. MANURIAL MANAGEMENT :

1. Did you apply FYM / compost to Sugarcane plot ? Yes / No

   If yes, what was the quantity ?
   ---------- tonnes / bullock cart loads.

2. When the FYM / compost was applied ?
   ---------- days before transplanting .

3. How FYM / compost was applied ?
   -- Mixed into soil
   -- Spread on the surface of the soil

4. Did you incorporate green manure to your sugarcane plots ? Yes / No

If yes, state whether,
-- green manure was raised in situ
-- green leaf manure was brought from outside.

5. Which of the green manure species incorporated ?

6. How many weeks did you allow green manure to grow?

7. When did you trample the green manure crop to soil?
_____ days before transplanting.

8. If the green manure was applied externally what was the quantity?
_____ tons/ha.

9 . Did you apply the available FYM/Compost/green manure to all the plots? Yes/No

B. SUGARCANE BASED CROP RESIDUE MANAGEMENT

1. Did you incorporate sugarcane trasj amd stibb;e to the plots? Yes/No

If yes, what was the quantity _____ tons/bullock carts.
If no, did you burn it in the plot itself?

2. Did you incorporate sugarcane trash to all the plots?

3. Did you apply any crop residue or press mud to sugarcane plots? Yes/No

4. If yes, state whether you much it on surface?
a) _ you incorporate in the soil?
b) _ Quantity applied _____t/ha.

C. SUGARCANE BASED CROPPING SYSTEM

1. Did you grow pulses or leguminous crop in the sugarcane plots as inter crops? Yes/No

If yes, state whether
a) you incorporate the stubbles of leguminous crop in the sugarcane plots?

b) Which crop was grown as intercrop? _____

c) What is the productivity of intercrop _____ Q/ha.

2. S-Y-S.

D. FERTILIZER MANAGEMENT

1. Did you apply fertilizer to the sugarcane crop? Yes/No

If yes, give details of the nature and quantity of fertilizer and time of application.

Nature of fertilizer	Basal dose		Top dressing
	Quantity	Time	

2. How the basal dose was applied?

- Mixed into the soil at the time of last ploughing in furrows.
- Applied on the surface of soil.
- Applied on standing water in the field.

3. Could you meet the full fertilizer requirement to all the plots? Yes/No

If no, the available fertilizer was

i. equally distributed to all the plots
ii. applied to all the plots but unequally
iii. applied to some plots and not applied to other plots.

4. Does your soil has calcium deficiency? Yes/No

If yes, a) have you taken up amendment measures?
b) what was the quantity applied_____kg/ha.

5. Des your soil has zinc deficiency? Yes/No

If yes, a) have you taken up amendment measures?
b) what was the quantity of ZnSO4 applied? _____kg/ha

6. Does your sugarcane fileds are salt affected? Yes/No

If yes, a) Did you apply required level of gypsum to soils?
- a week earlier to transplanting
- at the time of transplanting
- during crop growth period

b) What was the quantity applied? _____kg/ha.

7. Is your soil acidic in nature? Yes/No

If yes, did you apply lime to soil? Yes/No

- was it applied as per the recommendation? Yes/No
- when it was applied _____days before planting

II. WATER MANAGEMENT

1. Have you kept your sugarcane plots perfectly levelled?	Yes/No 3 0
2. Did you maintain adequate moisture in field after mixing organic manure?	Yes/No 2 0
3. Did you drain off the water before applying basal dose of fertilizer?	Yes/No 2 0
4. Did you drain of the excess water at the time of top dressing?	Yes/No 2 0
5. Did you stop flow of water from plot to plot after applying Fertilizers?	Yes/No 2 0
6. Did you irrigate the plot?	
- Once in 8 - 10 days gap	2
- No such gap given in irrigating the sugarcane plot	0
7. Irrigation is done based on -	
i) Irrigation to all the plots was done through a single plot	0
ii) Each plot was irrigated through separate water inlets	2
8. When there is shortage of water during summer, how did you overcome the problem?	
- Sugarcane trash is applied as much	2
- Mulching was not done	0
9. Is your soil salt affected?	Yes/No
If yes,	
i. Have you opened drains to drain out the excess water?	
ii. Changed the salt affected water and allowed fresh water frequency.	Yes/No

III. RATOON MANAGENEMT

1. Did you harvest the first main crop as for the recommendation?	Yes/No
2. Did you follow heavy and early earthing up of rations?	Yes/No
3. Did you do trash removing/burning in the fields?	Yes/No
4. Did you do stubble sharing in the sugarcane field?	Yes/No
5. Did you remove off bearing in the sugarcane field?	Yes/No
6. Did you do gap filling in the sugarcane field?	Yes/No
7. Did you apply fertilizer to the ratoon crop?	Yes/No

If yes,

give details of the nature and quantity of fertilizers and the time of application.

Nature of fertilizer	Basal dose		To dressing	
	Quantity	Time	Quantity	Time
1.				
2.				
3.				
4.				
5.				

8. Did you do all management practices as you have done for first (Main) crop? Yes/No

IV. INTEGRATED PEST MANAGEMENT

A. Prphylactic measures:

Did you practice any of the prophylactic practices owing the crops?

a. Fall ploughing: Fully/partially/no 2 / 1/ 0
b. Correct time sowing for chosen variety
c. Right variety for the time you were able to sow
d. Seed treatment
e. Precautionary sprays at nursery
f. Crop rotation with legume or green manure crop

B. Curative measures:

1. Mention the insects appeared during the crop growth period and the nature of control measures practiced if any during the previous year.

Nature of insects	Control measures
a.	
b.	
c.	
d.	

2. Which diseases were found on Sugarcane crop during the year 1994-95? What were the control measures practiced?

Nature of disea	Control measures adopted
a.	
b.	
c.	
d.	

3. What kind of weeds appeared in your rice fileds during the previous year?

Name of weed	Control measures adopted
a.	
b.	
c.	
d.	

V. SUBSCEPTIBILITY TO EXTRANEOUS FACTORS:

Could you please recall the extent of loss your crop suffered due to the following reasons:

Reasons	Yield loss (Qtls.)		
	Kharif	Rabi	Summer
a. Attack of pests and diseases			
b. Failure of rainfall/water supply			
c. Excess rainfall/floods			
d. Non availability of inputs			
e. Labour shortage			
f. Delay in harvesting due to marketing problems			
g. Total yield loss (a+b+c+d+e+f)			
h. How much yield did you get			
I. Expected yield (g+h)			

V. INFORMATION SELF RELIANCY:

Mention the extent of dependency for information on the following areas in yourself and others.

Sl. No.	Information	Source of information		
		Completely self	Partly self & partly others	Completely other
1.	Time of planting			
2.	Method of planting			
3.	Raising of seed nursery			
4.	Seed sets rate			
5.	Seed treatment			
6.	Veriety/ies			
7.	Organic manuring			
8.	Plant density			
9.	Time of fertilizer application			
10.	Nature of fertilizers			
11.	Quantity of fertilizers			
12.	Method of application			
13.	Identification of nutrient deficiencies			
14.	Amending deficiencies			
15.	Identifying insects			
16.	Controlling insects			
17.	Identifying diseases			
18.	Controlling diseases			
19.	Weed controlling			
20.	Water management			
21.	Time of top dressing			
22.	Fertilizer treatment			
23.	Tillage and cultural equipments			
24.	Ratoon management			
25.	SC based cropping system			
26.	Marketing of produce			

VII. INPUT SELF SUFFICIENCY:

Give details about the quantity of inputs used, value of those inputs and the sources from where they were obtained

Inputs used	Own source		Purchased	
	Quantity	Value	Quantity	Value
1. Seed sets				
2. FYM/compost				
3. Green manure				
4. Fertilizers				
5. Chemicals				
6. Human labour				
7. Animal labour				
8. Equipments				
9. Others (if any)				
Total :				

VIII. LAND PRODUCTIVITY

Could you please recall the total quantity of sugarcane produced on your farm:

Crops	Area under sugarcane	Total quantity of sugarcane produced	Inter crops	Quantity produced
1. Previous crop				
2. Second previous crop				
3. Third previous crop				
Total :				

$$LP = \frac{\text{Total quantity of sugarcane and intercrops produced from the 3 years}}{\text{Total area under sugarcane during the past 3 years}}$$

IX. INPUT PRODUCTIVITY

a) I) Total quantity of sugarcane produced during the year 1994-95 _____ tonnes

ii) Value of the total produce. Rs._____

b) I) If the sugarcane used for preparation of jaggery, the total quantity used _____ tonnes

ii) Value of total produce Rs._____

iii) Total quantity of stubble used as fuel _____ tonnes

iv) Total value of the stubble Rs._____

c) What was the cost of production? Rs._____

$$P = \frac{\text{Value of total output}}{\text{Total cost of production}}$$

APPENDIX IV

Score card for nutrient management :

	Activities	Score
1. Soil testing :	done long ago	1
	done recently	2
	not done	0
2. Organic manuring :		
a) Quantity :	more than the recommended	3
	as per the recommendation	2
	partially	1
	not applied	0
b) Time of application :	one month prior to transplanting	2
	two to four weeks before transplanting	1
	less than two weeks before transplanting	0
c) Method of application:	mixed thoroughly	0
	spread on the surface	1
d) Distribution :	applied equally to all plots	1
	applied unequally	0
e) Application of biofertilizers:		2
f) Application of crop residue		1
3) Inorganic fertilization :		
a) Nature of fertilizers :	single fertilizers	2
	complex fertilizers	1
b) Quantity of fertilizers :	full dosage (N: P: K:)	6
	partial dosage	3
	excess or not applied	0
c) Time of application :	basal + two top dressings	
	basal + one top dressing	
	basal only	
d) Method of application :	mixed at the time of last ploughing	2
	applied on the surface	1
	applied on standing water	0
e) Distribution :	equally applied to all the polts	2
	unequally applied to all the plots	1
	applied to some plots only	0
f) Treatment of urea for top dressing		1
g) Application of micronutrients		1
h) Application of soil amendments		1