

“SUSTAINABILITY OF RICE CULTIVATION IN HARYANA”

BY

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*Thesis submitted to the Chaudhary Charan Singh
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of the requirements for the degree of:*

*DOCTOR OF PHILOSOPHY
IN
EXTENSION EDUCATION*



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2002

**DEDICATED
TO MY
BELOVED MOTHER**

CERTIFICATE - I

This is to certify that this thesis entitled "**Sustainability of Rice Cultivation in Haryana**" submitted for the degree of **Doctor of Philosophy**, in the subject of **Extension Education**, to the CCS Haryana Agricultural University, Hisar, is a bonafide research work carried out by **Mr. Dharmendra Kumar Shivrain**, under my supervision and that no part of this dissertation has been submitted for any other degree.

The assistance and help received during the course of the investigation have been fully acknowledged.



(Dr. V.K. Makhija) Professor
Major Advisor

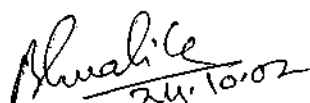
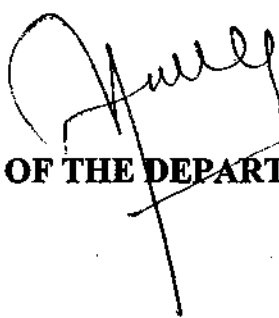
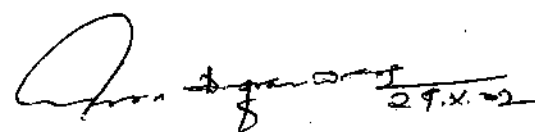
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CERTIFICATE - II

This is to certify that this dissertation entitled, "**Sustainability of Rice Cultivation in Haryana**" submitted by **Mr. Dharmendra Kumar Shivrain**, to Chaudhary Charan Singh Haryana Agricultural University, Hisar, in partial fulfillment of the requirements for the degree of **Doctor of Philosophy** in the subject of **Extension Education** has been approved by the student's advisory committee after an oral examination on the same.


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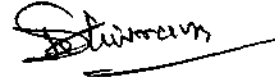
I am obliged to the respondents who extended their unreserved co-operation during data collection without which the research work would have remained unaccomplished.

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Hisar

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(Dharmendra Kumar Shivrain)

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LIST OF ABBREVIATIONS

1.	ADO	-	Agriculture Development Officer
2.	CAO	-	Circle Agriculture Officer
3.	CCS HAU	-	Chaudhary Charan Singh, Haryana Agricultural University
4.	CV	-	Co-efficient of variation
5.	Ha	-	Hectare
6.	HYV	-	High Yielding Varieties
7.	KGK	-	Krishi Gyan Kendra
8.	KVK	-	Krishi Vigyan Kendra
9.	NGO	-	Non Government Organization
10.	NSS	-	Not so serious
11.	S	-	Serious
12.	SD	-	Standard Deviation
13.	SES	-	Socio-Economic Status
14.	SRCT	-	Sustainable Rice Cultivation Technology
15.	TAJS	-	Training Associate-cum-Junior Scientist
16.	VEW	-	Village Extension Worker
17.	VS	-	Very Serious

CHAPTER - I

Introduction

Situation of conflict between socio-ecological requirements and economic compulsions could be traced back to the earliest human settlements. Probably, the evolution of human race from food gathering existence to that of settled agriculture was the result of such a crisis (Cohen, 1977). As increasing population pressed on shrinking wild food resources, there was an implicit assumption that settled agriculture would have the crucial advantage of greater productivity. Later, throughout the 10,000 years of its existence, the social mandate of agriculture remained focused on increasing production (Conway, 1987), the justification obviously being the fear of a Malthusian trap.

The high input technology driven model was instrumental in increasing crop yields globally. Most of the developing countries like India, which were plagued by severe food crisis replicated the success achieved by this model in the first world countries under the aegis of green revolution. Central to this production oriented system was the assumption that

technologies were universal and they existed independently of social and ecological contexts (Dahlberg, 1986). However, this assumption could not suit the complex, diverse and risk prone environments of resource poor agriculture, mostly in the developing countries. After this early sensibility, agriculture development efforts became focused on changing the local socio-economic environments to suit technology through subsidies and incentives (Pretty, 1996). Though this approach succeeded in meeting many ambitious production targets, the benefits were distributed in favour of resource rich farmers. Moreover, fuelled by the single motive of high production, technological innovations favoured an over exploitation of biological resources and weakening of the traditional approaches causing total marginalisation of poor, small and marginal farmers.

The disillusionment over this conventional approach in agriculture was on the rise since the early years of 1980s. Jackson (1980), Dover and Talbot (1987) and Conway and Barbier (1990) were some of the fore runners who called for a qualitative shift in priorities and practices favouring resource conserving technologies in agriculture. In the face of unprecedented challenges of growing population demand (8.4 billion in 2020), falling yields due to resource depletion and persistent poverty and malnutrition, they formulated new hypothesis and applied different methodologies in attempts to improve the livelihoods of rural poor. This gave rise to the new socio-ecological paradigm, popularly known as sustainable agriculture.

Sustainable agriculture

It was the Bruntland Commission report in mid 1980s, that directed the attention of the international community to the resource regenerating model of sustainable agriculture.

Infact, sustainable agriculture developed in response to concerns about impacts of modern agriculture such as depletion of non-renewable resources, soil degradation, health and environmental effects of agricultural chemicals, inequity, declining rural communities, loss of traditional values, food quality, farm worker safety, decline in self-sufficiency and decreasing number and increasing size of farms (Dahlberg, 1986).

The definition of sustainable agriculture encapsulated in Agenda 21 of UNCED, 1992 identified the following common criteria :

- * Continued productivity of agriculture for long time scale relative to human life.
- * Maintenance or improvement of agriculture's natural resource base.
- * Minimising adverse environmental impacts from agriculture on surrounding lands and on people.
- * Social equity within agriculture and between rural and other sectors.

Thus sustainable agriculture represent productive, environmentally sound, economically viable and socially desirable agriculture based on adapting technologies to suit a particular agro-ecosystem (Grove and Edwards, 1993).

The problem

Indian agriculture has witnessed a phenomenal growth since independence. Compared to 51 M tonnes in 1951, India attained a foodgrain production of 203 million tonnes during 1999-2000. However, in recent years, the growth which was triggered by massive public investments in agricultural research and extension, increase in agro-inputs and policy support in the form of subsidies and incentives have started waning. Echo of discussions of fatigue from green revolution regions is becoming louder because of threatened farm efficiency, shrinking resource base and environmental degradation. These issues have prompted farm scientists and policy makers to seriously examine the alternatives to the high input agriculture. Sustainable agriculture backed by green technologies in an integrated farming system has been considered a promising and potential pathway.

Rice is the main staple food crop for the majority of the population of the country. In India, during 1999-2000, rice was grown over an area of 44.59 million hectare and the production was 85.99 million tonnes. In Haryana also rice is grown over vast area. During 1999-2000, about 1.08 million hectares of area was under rice cultivation in the state. The production of rice during the year was 2.42 million tonnes (Statistical Abstract, 2001).

However, the yield of rice has been more or less stagnated. Number of other problems have arisen i.e. degradation/depletion of soil fertility increased epidemic of insect, pest and diseases, infestation of weeds, decline

in water table etc. In addition to above physical and technical constraints the farmers have experienced a continuous escalation in cost of production in relation to income, resulting in decrease in relative returns. All these factors might threaten the economical and physical sustainability of this crop.

Keeping in view the ever increasing population, depletion of natural resources, environmental pollution and limitation of sustainable agriculture, which provoked the researcher to undertake a study on the proposed topic i.e. "Sustainability of rice cultivation in Haryana."

The following objectives were framed for the present study:

1. To assess the attitude of farmers and extension workers about concept of sustainability as applied to rice cultivation.
2. To find out the level of knowledge and adoption of recommended practices for sustainable rice production and to identify the constraints in adoption of sustainable practices as perceived by farmers.
3. To identify indigenous practices being followed by farmers to maintain sustainability with respect to rice cultivation.
4. To suggest an extension strategy to promote the adoption of sustainability related practices.

Scope of Study

The issue of sustainability have become increasingly important to policy makers farmers and the public. The findings of the study will provide thrust areas for strengthening the cause and concern for sustainable

agriculture to the researchers' insight and broader vision to planners and policy makers for planning and policy formulations. Moreover, it will provide awareness to make more informed choices for better agriculture on sustainable lines to educators, students extension personnel and farming community at large and also to those who share an interest and concern for sustainable agriculture, which include civic minded citizens and those involved in environmental and ecological activities.

Limitations

Sustainable agriculture practices are not a well defined set of practices. The concept of sustainability is complex, non linear and dynamic and includes wide range of technological, management, biological ecological and related options. Owing to broadness of concept and time constraints of students research the study had limits to generalization of the finding. However, the results specification will speak for the possible ways and means to come up with terms and concepts on sound and alert footing.

The data for the study was collected from two districts, viz. Kaithal and Karnal of Haryana State in the year 2001 though, it is presumed to be a representative sample spread over the main cultivation belt of Haryana, yet it would have been better if a larger sample size is taken covering more crops. However, in student research limitations of time and financial constraints existed. In spite of these constraints considerable care has been energized to make the study more objective and systematic as far as possible.

CHAPTER - II

Review of Literature

The chapter presented an overview of past researches which were directly or indirectly relevant to the present study. An intensive search was made by the author to find out researches relating to sustainable agriculture, attitude, knowledge, adoption, constraints, indigenous practices, and their association with independent variables. A brief resume of important relevant research reviews have been presented under the following sub-heads:

2.1 Sustainable agriculture

2.1.1 Origin and evolution of sustainable agriculture

2.1.2 Dimensions of sustainable agriculture

2.1.3 Defining the concept of sustainable agriculture

2.2 Attitude towards sustainable agriculture and its association with adoption of sustainable practices

2.3 Knowledge level of production technology

- 2.4 Association of background variables with knowledge level about production technology
- 2.5 Adoption level of production technology
- 2.6 Association of background variables with adoption level of production technology
- 2.7 Constraints in the adoption of production technology and suggestions
- 2.8 Indigenous practices being followed by farmers

2.1 Sustainable Agriculture

2.1.1 Origin and evolution of sustainable agriculture

Sustainable agriculture is not exclusively a concern of the present days. Johnson (1995) quoted an ancient Sanskrit text from about 1500 BC which read as "Upon this handful of soil our survival depends. Husband it and it will grow our food, our fuel and our shelter and surround us with bounty. Abuse it and the soil will collapse and die, taking man with it". Similar examples are reported in the works of ancient Greek philosopher Plato and also from medieval period.

However, prior to late 1970s, agricultural sustainability received relatively little attention in the development and environment circles. Even Rachel Carson's widely circulated book "Silent Spring" of 1962 focused more on threats of pesticides to fish, wild life and human health rather than on the ecological integrity of agricultural systems. Hence, the concept of

sustainability first mooted by Maurice. F. Strong at the Stockholm conference of UN in 1972 was soon dismissed as an ideological or philosophical concept and the constituency of sustainable agriculture was confined mainly to a few organic farming groups in the developed countries and the pioneering works of Rodale institute.

Buttel (1993) focused on farm crisis of mid eighties resulting from the growing reports on the plateauing of production curves, increasing farm debt loads and inequities and the global collapse of farm prices that gave credibility and lent urgency to the claim that conventional agriculture (High input technology model) cannot be sustained in the long run. It provided a compelling rationale for researching and adopting production systems based on minimizing the use of purchased inputs”.

The report of WCED, 1987 chaired by Gro Harlem Bruntland and co-authored by Robert Chambers, Calestrous Juma and Lester Brown was a catalytic force in the dissemination of the concept of sustainable development both in the developed and developing countries. Later years of this century has seen the development of the concept as an alternative model especially for agricultural development.

2.1.2 Element of sustainable agriculture

Khosla (1987) opined that sustainable development to be planned with the factors as resource conserving, waste reducing, socially compatible,

equitable, economically efficient, employment generating, need fulfilling and self reliant.

Brklacich (1989) characterized the elements of a sustainable production system as food sufficiency, resource stewardship and producer community dimensions.

Swaminathan (1989) identified the chief components of sustainable agriculture such as conservation of biological diversity, conservation and management of water resources, prevention of soil erosion and promoting the adoption and development of ecologically sound and economically viable farming techniques.

Eswaran and Viramani (1990) opined environmental soundness, social acceptability, technological feasibility, economic viability, political desirability and administrative manageability as the main elements of sustainable agriculture.

Jodha (1991) identified dimensions of sustainability as the intergenerational equity that is, future generations should have equal or more prospects than the present ones, and primacy of the biophysical resource base of the system in conditioning such equity – that is, minimizing potential degeneration of the resource base in course of human efforts to maintain or raise performance of system.

Hailu and Metzger (1992) enumerated the two key dimensions of sustainability of agriculture as environmental and socio-economic

dimensions. Environmental dimension encompassing maintenance of environmental quality and remaining robust against external stress or major disturbances. Where as socio-economic dimension included satisfying societies future needs for food and fibre along with assuring the economic and social well being of producer.

Dunlap *et al.*, (1992) identified the major dimensions for sustainability of farming system as ecological, socio-economic and ethical dimensions.

Reijntjes and Bayes (1992) revealed ecological soundness, economic viability and acceptability as the major dimensions of sustainable agriculture.

Saleth and Swaminathan (1993) conceptualized sustainable agriculture on the basis of three basic components as ecological security, economic efficiency and social equity – both in intra and inter generational contexts.

Hamblin (1994) identified the major elements of sustainability as

- inter-sectoral economic interactions (agriculture to other sectors of the economy)
- human resources (labor force, social constructs)
- productivity (in monetary, energy or material units)
- natural resources base quality (land, water, air and biota)
- off-site physical impacts (on other land-users and uses)
- and off-site social impacts (rural-urban effects)

Katyal (1997) revealed the basic dimensions of sustainable agriculture production, quality of endemic natural resources and quality of other ecosystems which are influenced by agricultural activities.

2.1.3 Defining the concept of sustainable agriculture

Neufeldt (1988) defined sustainability as the ability to 'keep in existence, keep up; or prolong.

American society of Agronomy (1989) meant by sustainable agriculture as one that over long term (1) enhanced environmental quality and the resource base on which agriculture depended (2) provided for basic human food and fiber needs (3) was economically viable and (4) enhanced the quality of life for farmers and the society as a whole.

Pezzey (1989) viewed that an agricultural system could be called sustainable if it provided adequate economic returns to farmers, indefinitely maintained the natural resources and productivity, minimized adverse environmental impacts, optimized production with minimal external inputs, satisfied human needs for food and income and ultimately provided for the social needs of farm families.

Abrol and Katyal (1990) opined that the term sustainable agriculture implied endurance of productivity level through certain agricultural practices over a period of time.

Conway and Barbier (1990) suggested that agricultural sustainability could be defined as the ability to maintain productivity whether of a field or farm or nation in the face of stress.

Reganold *et al.*, (1990) concluded that to be sustainable, a farm must produce adequate food of good quality, be environmentally safe, protect the resource base and be profitable.

FAO (1991) defined sustainable agriculture 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.

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

Altieri (1992) viewed that the goal of sustainable agriculture was to maintain agricultural productivity with minimal environmental impact and also assuming adequate returns while providing for the social needs of the entire population.

Hamblin (1992) defined sustainable agriculture as the situation where agriculture remained the dominant land use over time and the resource base could continually support production at levels needed for survival and profitability.

Katyal (1997) opined sustainable agriculture as a means to meet continuously the changing needs of man and his animal support system while remaining economically viable at the increasing productivity levels and ensuring biosphere security through conservation and successful management of resources.

2.2 Attitude towards sustainable agriculture and its association with adoption of sustainable practices

Weigel (1985) stressed that strong linkages between attitude and behavior and could be predicted when the level of correspondence between them was high.

Latha (1990) revealed that the users had a more favourable attitude towards biogas technology than the non-users.

Beus and Dunlap (1991) stated that a relation could be expected between farmers' attitude towards sustainable agriculture and their farming practices on the basis of correspondence principle which suggested that specific attitude were better predictors of specific behaviour.

Beus and Dunlap (1994) reported that the measure of adoption of sustainable agricultural practices viz. reduced pesticide use, organic fertilizer use, home garden and diversity combined into an adoption index correlated strongly with their attitude towards alternate agriculture.

Salitiel *et al.*, (1994) theorised that favourable attitude towards sustainable agriculture had a significant direct effect on the adoption of management intensive sustainable practices (MISP) in agriculture.

Allen and Bernhardt (1995) suggested that a relationship did existed between production practices followed by farmers and their specific attitude related to agricultural production paradigms (Conventional or sustainable paradigms).

Hanson *et al.*, (1995) reported that an unfavourable attitude was shown towards sustainable agriculture by about 53 per cent of farming families in USA due to their perception of lower yields in sustainable farming.

Krishnakutty (1995) reported that both farmers and development officials of Kerala had a moderate level of favourable attitude towards sustainable agriculture.

Reddy (1995) asserted the need to include the awareness and attitudes of the people at the grassroot level towards environment and sustainability of agriculture especially in fragile resource regions in order to evolve better development programmes.

Stevens *et al.*, (1995) reported that the decisions affecting people were made without adequate knowledge of their attitudes and practices towards wetlands and their resources.

Pyrovetsi and Daoutopoulos (1997) revealed that the wetland farmers of Greece had a negative attitude towards the wetland resource use and seemed to be ignorant of conservation issues or the impact of agricultural practices on environment.

2.3 Knowledge level of production technology

Mathur (1970) observed that people did not adopt a new idea as soon as they become familiar to it. They may wait for several years to try it on their farms. So the final decision of farmers to use a new practice is usually the result of their knowledge of practice and attitude towards it operating through time.

Patil (1982) concluded that majority of the respondents were aware of recommended practices like FYM application, application of N fertilizers, name of recommended varieties but application of P and K were known to 40-50 per cent respondents. The knowledge about spacing, seed rate, plant protection measures were observed to be poor.

Sinha (1982) reported that irrespective of small, medium and large group of farmers had very good knowledge about seed rate, sowing time and irrigation practices but they had very poor knowledge about seed treatment, and plant protection measures of wheat cultivation.

Sharma (1986) found that maximum percentage (36%) of the respondents carried medium level of knowledge about recommended

agricultural practices. Those who belonged to low and high knowledge categories were 34 and 30 per cent, respectively.

Mundhva and Patel (1987) disclosed that majority of the wheat growers had a medium level of knowledge of the cultivation practices.

Nikhade *et al.*, (1990) pointed out that majority of the paddy growers were aware about the improved varieties. More than 60 per cent of the respondents had knowledge about use of green manures and fertilizers. Knowledge about insect pest control was satisfactory but regarding disease control it was poor.

Ratnakar and Readdy (1991) reported that majority (53.1%), of the tribal farmers had low level of knowledge about recommended practices of paddy.

Bhatia (1991) concluded that sugarcane growing farmers had moderate level of knowledge. Knowledge level of fertilizer and irrigation aspects was high but poor in plant protection aspect.

Bavalatti and Sundaraswamy (1991) observed that majority of the respondents (57.34%) belonged to medium knowledge category in respect of dry farming practices. Almost equal number of respondents were in high (22%) and low (20.66%) knowledge categories.

Kumar (1992) reported that farmers had poor knowledge (27.8%) about gram production technology. The knowledge regarding improved

variety was almost absent whereas knowledge of agronomic practices was fair.

Chand (1994) found that the knowledge of farmers regarding seed treatment, green manuring and plant protection measures was very low, knowledge regarding rice varieties was poor (54.9%). Majority of the farmers (66%) had knowledge of more than 50 per cent of the recommended dose of fertilizer. Farmers knowledge about seed rate, sowing time and water management was satisfactory.

Das (1996) found that 81.53 per cent of sorghum growers had maximum knowledge on agronomic practices, the knowledge level about irrigation was found (68%) about fertilizer application (61.33%) and about varieties (60%). He further found that minimum knowledge level of the farmers was about plant protection measures to the extent of 50.02 per cent.

Thakur (1996) found that neighbour and friends were the major sources utilized by the tribal farmers. Majority of them possessed medium level of knowledge regarding recommended niger production technology whereas majority of them did not know about fungicides (94%) depicting very poor level of knowledge in case of varieties (54%) and nursery management (84%).

Ramesh Chand *et al.*, (1997) reported that less than half of the number of farmers had correct knowledge about seed rate (47%), sowing time of nursery (48%) and chemical weed control (36%).

2.4 Association of background variables with knowledge level about production technology

Nirwal (1982) observed a positive and significant association between family education and knowledge of crop production technology of the farmers with irrigated holding.

Baadgaonkar (1983) reported that there was significant correlation between education, annual income, social participation and knowledge. He found no correlation of age and extension contact with knowledge.

Reddy *et al.*, (1987) observed a significant association between knowledge and attitude.

Mundhva and Patel (1987) found that farmers age, education, farming experience, caste, extension contact, land holding, SES and annual income had a close correlation with their knowledge level.

Kher and Halyal (1988) found that education, social participation and extension participation index were positively and significantly associated with sugarcane growers' knowledge about sugarcane production technology.

Panjabi and Lakhera (1988) and Vijay Raghavan and Somasundaram (1979) reported that SES had a positive and significant relationship with knowledge.

Singh (1990) brought to light that the size of holding and extension contact had a positive and significant relation with the knowledge of paddy growers.

Bavalatti and Sundaraswamy (1991) reported that extension participation exhibited a positive and significant relationship with knowledge level of dry farming practices.

Singh *et al.*, (1991) concluded that socio-economic status (SES), extension contact, cosmopolitaness, social participation, farm experience and innovation-proneness had significant negative correlation with the knowledge gap of citrus growers.

Kumar (1992) found a positive relationship of the farmers education, family education, extension contact, mass media exposure and SES with their knowledge level on gram production technology. Age of the respondents also had a significant but negative relationship with knowledge level.

Thoronetharan *et al.*, (1998) revealed that higher utilization of various information sources and mass media by the respondents would have helped them to possess relatively more knowledge on recommended agro-forestry practices.

2.5 Adoption level of production technology

Padheria and Patel (1975) found that adoption of recommended seed rate was higher among the farmers. The author further reported that

majority of the respondents had not adopted any plant protection measures and practice of seed treatment was also negligible among farmers.

Sundaraswamy and Doraiswamy (1975) observed that majority of the growers (62%) were in medium level of adoption. They also observed that 40 per cent applied fertilizer as per recommendation and 51 per cent at different levels. They further observed that none followed recommended plant protection schedule.

Tripathy (1977) reported that 33 per cent of the farmers were in low adoption category whereas a majority of them (63%) were in the moderate category and only 3.5 per cent were found in the high category.

Singh (1978) in his study observed that majority of the respondents (70%) adopted HYV seed of paddy on 100 per cent of their holdings and non-adopters only 2 per cent. Seed treatment practices were not adopted by 40 per cent respondent and only 2 per cent adopted the recommendations in full. Line transplantation was almost rejected. There was good adoption of N fertilizers and zinc but non-adoption or poor adoption was noticed in case of potashic fertilizers.

Joshi (1979) observed no varietal gap in sugarcane cultivation.

Mukhopadhyay (1979) did not find any varietal gap in wheat cultivation.

Ray (1980) observed that only 20 per cent contact farmers and 4.17 per cent fellow farmers adopted seed treatment in paddy cultivation.

Patil (1982) reported that majority of the farmers (63.02%) used higher seed rate and also observed that majority of the farmers (60.94%) did not treat their seed at all.

Rotti (1983) concluded that majority of the respondents had the knowledge and adopted the recommended practices like sowing time, seed rate, spacing, variety, FYM dose, nitrogen and phosphorus doses and top dressing. Seed treatment and chemical weed control were adopted only by few farmers and plant protection measures were adopted by none.

Agarwal (1984) observed a wide variation in the adoption level of plant protection measures against insect pests and diseases. The mean adoption level (41.2%) in plant protection measure was found to be low.

Singh (1984) observed that more than 75 per cent of the respondents were high and medium adopter in equal proportion whereas only 23 per cent belonged to low adopter category. More than 68 per cent of the respondents adopted HYV of paddy. None of them adopted recommended seed rate for raising nursery. The practices of line transplantation was almost not adopted by all respondents. Majority of the respondents had adopted recommended doses of chemical fertilizer and chemical weed control measure.

Ballabah and Prasad (1985) found that on an average, adoption level of farmers was 44 per cent. The level of adoption was low in plant

protection measures (65%). It was minimum in the use of HYV seed (31%) followed by chemical fertilizer (37.75%).

Jaiswal and Rathore (1985) commented that technologies of wheat production adopted more by the farmers having irrigation. The adoption level was lower in case of unirrigated farmers than the irrigated farmers.

Verma (1985) reported that the adoption level of rapeseed and mustard production technology among the farmers was found to be quite satisfactory with regard to agronomic practices in general and improved varieties in particular. The adoption of manure practices was not upto the mark.

Osun *et al.*, (1986) reported that 69 per cent of the rice farmers, were following recommended farm practices for rice production in their study area in Nigeria.

Rai *et al.*, (1986) reported that all the respondents used fertilizer, in paddy crop but the use of recommended doses of fertilizers, was very rare.

Sharma (1986) observed that among the wheat growers the percentage of high, medium and low adopter categories were 18, 47 and 35 percent, respectively. Seed rate was adopted by 68 per cent of the respondents whereas only 28 per cent respondents adopted seed treatment.

Dewan (1987) concluded that majority (76%) of the farmers were in lower level of adoption of the package of practices of large cardamom.

Singh and Sharma (1988) reported that majority of the paddy growing farmers failed to utilize available technology in raising quality nurseries for paddy. The study showed that none of the respondents adopted recommended seed rate which may have been due to lack of knowledge.

Goyal (1990) found that 19 per cent of the respondent belonged to the low adopter category, 62.0 per cent to the medium adopter category and remaining 19.0 per cent were in the high adopter category in respect of gram production technology.

Saxena *et al.*, (1990) reported that only 17.6 per cent of the farmers had adopted the package of practices of wheat under rainfed condition in full while majority of the farmers (49.6%) had adopted partially.

Srivastava and Singh (1990) found that adoption level was lowest in use of P fertilizer followed by N fertilizer, improved seed use and preparation of land respectively regarding paddy production under rainfed condition.

Bhatia (1991) observed that majority of the respondents (60%) had a low level of adoption. Adoption level was lower in plant protection measures and it was in medium level in other aspects of sugarcane production technology.

Chandargi *et al.*, (1991) stated that more than 80 per cent of the jowar farmers had adopted the practices like variety, seed rate and time of sowing whereas the practices like spacing, compost, manuring the chemical

fertilizers were adopted in full by less than 80 per cent farmers, pest and disease control was not adopted by any farmers.

Bangarva *et al.*, (1993) found that majority of the farmers had low level of adoption in practices like seed treatment, plant protection measures, irrigation application, improved varieties and fertilizer but comparatively high level of adoption was found in practices like seed rate, spacing and depth of sowing in respect of groundnut production technology.

Sherawat and Kharub (1993) observed in their study that majority (70.2%) of the respondents came under medium adopter category in respect of cotton production technology.

Gupta, *et al.*, (1996) found that there was highest adoption of agronomic practices (65.53%) and lowest in case of plant protection practices (34.89%).

Khan *et al.*, (1997) reported that adoption of recommended paddy cultivation technologies it was found that 52.00 per cent of the respondents were adopting the seed treatment methods, whereas herbicides and fungicides were adopted by only 14.00 and 11.00 per cent of the respondents, respectively.

Sharma (1997) reported that majority of the farmers (77%) did not adopt any recommended varieties of gram whereas, 23 per cent adopted the varieties recommended by the scientists of CCS HAU, Hisar. As for as

agronomic practices are concerned 55% farmers had adopted medium level of adoption followed by low and high (23%).

Maraty and Reddy (1998) reported that majority of the farmers had medium level of adoption (61.6%) of paddy production practices.

Singh (1998) observed that 33 per cent of farmers belonged to low adoption level category while 36 per cent of them were observed in medium category followed by 31 per cent in high adoption level category in case of adoption of improved kinnow production technology.

Suresh Chander (1998) observed that majority of farmers were having low level of adoption for mechanical control of weeds and medium level of adoption for chemical control of weeds. For total protection practices there was medium to high level of adoption.

Satpal Singh (1999) stated that a majority of the sunflower growers had medium to high level of adoption. The adoption level of improved varieties and agronomic practices were comparatively high (70.5% and 69.9%, respectively) and it was medium in fertilizer (49.5%) but poor in case of plant protection measures (24%).

Sube Singh (1999) found that mean adoption level of recommended practices of mushroom cultivation was 77.14 per cent. The adoption was better in case of 'spawn and spawning' and cropping practices. It was low in compost preparation.

Jana (2000) reported that most of the respondents had high level of adoption on cultivation of resistance varieties against insect-pests and diseases (63%). They had medium level of adoption on disease control after transplanting (30%) and manual weed control (45%). It was found to be low on wet seed treatment (15%), insect pest control before transplanting (1%) and after transplanting (12%), disease control before transplanting (14%) and chemical weed control (7%).

2.6 Association of background variables with adoption level of production technology

Singh and Singh (1970) reported that education status of family was positively and significantly related with adoption behaviour of the farmers.

Singh (1979) reported that farmers' social participation status of family was positively and significantly related with adoption behaviour of the farmers.

Honde (1980) came to conclusion that there was a significant association between adoption of improved practices of sugarcane cultivation by the farmers and their education, size of their family, size of operational holding, annual gross income, SES, social participation, extension contact, aspirations, risk-orientation, their attitude towards improved practices of sugarcane cultivation and knowledge of improved practices of sugarcane cultivation.

Ferreira *et al.* (1984) conveyed that adoption of maize production technology was positively correlated with social participation, cosmopolitaness, utilization of rural credit, extension contact and farm size of the maize growers.

Salunkhe (1984) concluded that size of holding, SES, social participation and attitude were positively related with adoption. Age was found to be negatively correlated with adoption.

Jagtap (1985) indicated that education, size of land holding, annual gross income, SES, social participation, credit orientation, attitude, and knowledge were positively correlated with adoption. Age was found to be negatively correlated.

Osum *et al.* (1986) reported that extension contact and mass media exposure were found to be significantly related to the adoption of recommended practices.

Reddy *et al.* (1987) stated that there was significant association between attitude and adoption with respect to adoption of improved package of practices in paddy production.

Igodan *et al.* (1988) observed that occupation, family size, education, literacy, social participation and extension contact were significantly related to the adoption of recommended farm practices for maize production in Nigeria.

Santra *et al.* (1988) reported an association between social participation of jute growers and their adoption behaviour.

Tyagi and Tyagi (1988) concluded that education and credit were the most important determinant of adoption in small farmers. Credit orientation was important in medium farmers. Among big farmers education and family type were most important in sugarcane cultivation.

Bavalatti and Sundaraswamy (1990) disclosed that the adoption level of dry farming practices exhibited a positive and significant relationship with land holding and extension participation.

Hossain (1990) found a negative correlation between farm size and adoption of modern varieties of rice in Bangladesh. Literacy had a positive impact on fertilizer use.

Saxena *et al.* (1990) pointed out that caste, size of land holding, education of the farmers, extension contact had significant relationship with the adoption of dry land technology in wheat. Age had no significant relation with adoption.

Singh and Rajendra (1990) conceptualized that age, education, caste structure, land holding, SES, social participation and extension contact were found to have positive and significant association with adoption of improved sugarcane variety.

Singh and Sharma (1990) reported that higher SES, size of holding, attitude and social participation and irrigation facilities had a positive relationship with adoption in gram production.

Supe *et al.*(1990) found a significant relationship between adoption and education, social participation, land holding, SES, scientific orientation and attitude towards HYVs among the jowar growing farmers. The age of farmers had no relation with the adoption behavior of the farmers.

Juliana *et al.*(1991) concluded that adoption of integrated pest management was positively and significantly associated with extension agency contact irrespective of marginal, small and big farmers.

Chaudhary and Makode (1992) indicated a positive and significant relationship between SES of the farmers and their level of adoption of HYVs of rainfed chilli and jowar.

Kumar (1992) reported that age of the respondents was found to have significant but negative association with adoption of gram production technology. He further added that education, SES, mass media exposure, family education and knowledge of respondent had a significant positive relationship with the adoption level of farmers.

Singh (1993) concluded that education, socio-economic status, family education, extension contact, mass media exposure, fatalism, scienticism, risk preference and innovativeness had positive and significant

relationship with adoption of package of practices of cotton production technology.

Naryana and Reddy (1994) concluded that contributory positive relationship with adoption was found in case of certain selected independent variables which was more predominant in small farmers as compared to marginal farmers.

Das (1996) concluded that education, farm power, land holding, material possession, social participation, socio-economic status, economic motivation, extension contact, change proneness and mass media exposure had positive and significant relationship with adoption of package of practices of sorghum production technology.

Singh *et al.*, (1996) concluded that the discriminant function coefficients indicated that extension contact, socio-economic status, attitude of farmers towards cotton crop, extension participation and age of farmers had significant relationship with adoption.

Bhople *et al.*, (1998) revealed in their study that SES, psychological makeup and extent of exposure and contact with outside agencies of the sericulturists were positive in relation with adoption of sericulture technologies, but risk orientation/preference and mass media exposure did not show any relationship with adoption and these were not upto the significant level.

Singh (1998) revealed that education, SES, extension contact, mass media exposure, risk orientation were positive and significantly correlated with knowledge and adoption level of respondents at 5% level of significance in kinnow production technology.

Sube Singh (1999) revealed that education, family education, SES, extension contact and risk orientation were found to have positively significant relationship with adoption level.

2.7 Constraints in the adoption of technology and suggestions

Wagmare and Pandit (1982) reported that lack of knowledge and lack of technical guidance about new varieties were the main constraints in use of improved variety and seed treatment. Lack of technical guidance and high cost of chemical fertilizers were expressed as constraints by majority of the respondents.

Baad Gaonkar (1983) reported that the reason for partial adoption of chemical fertilizers, seed treatment and plant protection measures were either their non-availability or financial difficulties or high cost.

Kunnal *et.al.* (1984) observed that high cost of various inputs for different crops affected the adoption by farmers.

Singh and Mathur (1984) found that poor knowledge about application of nitrogenous fertilizers resulted into partial adoption of the practices. Small and medium farmers felt lack of knowledge as most serious

constraints with respect to use of plant protection measures in bajra cultivation.

Verma (1985) concluded that lack of finance for purchase of fertilizers was the problem encountered by majority of the farmers.

Misra *et.al.* (1986) in their study production constraints of rainfed land rice in Eastern India observed that socio-economic constraints which induces rice prices and marketing, the farmers' resource base including farm size, fragmentation, irrigation potential, the profitability and riskness of input use specially fertilizer, crop insurance and the prevailing poverty in the region are the major reasons for low yield of paddy.

Shenoi and Mandal (1986) concluded that three socio-economic factors restrain transfer of technology for rice production, viz, land tenure system, population pressure and lack of financial capacity of small farmers. They suggested three medium term measures which could affect the needed transfer of technology, viz, adoption of low cost technology, improvement in the extension system and cooperative arrangements for the supply of inputs and credit services.

Singh and Sharma (1986) concluded that over 90 per cent of respondent farmers perceived the production inputs, viz, HYV seeds, chemical fertilizers, farm credits, agrochemical and irrigation facilities "Very costly". Inadequate credit facility, lack of knowledge about how to avail credit facilities, lack of electricity for running tubewells, frequent power

breakdown, high cost of diesel and mobile oils, were also the important constraints. Lack of remunerative prices for the farm produce and lack of knowledge for application of knowledge in the practical field were also perceived by more than 80 per cent of the respondents as major constraints.

Bhatol (1987) concluded that among different constraints low price of produce, high cost of seeds, high wages of labour and non-availability of labour were major constraints faced by paddy cultivators.

Kothikhane *et al.* (1987) observed that high cost of inputs like fertilizers, pesticides, non-availability of inputs at proper time, low price of farm produce, non-availability of resources at farmers' level were some of the constraints as expressed equally by small, medium and big farmers for adoption of technology.

Chowdhury and Dasgupta (1989) concluded that small holdings, financial limitations and lack of timely assured irrigation, high cost of inputs were the most important factors for non adoption of improved agricultural technology.

Nikhade and Bhople (1989) stated that the reasons for non-adoption of recommended technology for various crops were mostly lack of capital, non-availability of inputs in time, high cost of inputs. Lack of technical knowledge and skill were also other major constraints reported by cultivators.

Rane (1989) pointed out that shortage of labour, low price of the produce, non-availability of loans, high prices of improved seed were the major constraints perceived by the paddy growers.

Umesh and Bisliah (1989) summarized constraints like input availability and their cost credit marketing and technological guidance in achieving higher productivity.

Bhoite and Dusane (1990) observed that non-availability of seed, lack of knowledge about seed treatment, adulteration in seed, high cost of seed were major constraints in the adoption of sunflower technology.

Jaiswal and Sharma (1990) stated that unavailability of seed in proper time, high cost of input, lack of knowledge about correct dose of seed, lack of technical guidance, lack of interest and involvement of high cost were the major constraints for non adoption of improved rice production technology.

Misra (1990) opined that steep rise in the cost of agricultural inputs had made farming almost uneconomical.

Srivastava and Singh (1990) identified three major constraints in paddy production as high prices of fertilizers, lack of irrigation facilities, non-availability of improved seed, lack of technical knowledge, low price of farm produce, lack of capital and non-availability of credit.

Girase and Kamble (1991) reported that the major constraints in adoption of plant protection practices in bajra crop were high cost of insecticide and pesticide and lack of knowledge regarding use of pesticides.

Laharia and Bhatti (1991) observed the constraints in promotion of biogas technology which were identified as locational, social and economic with some respondents facing psychological barriers.

Lakhera and Panjabi (1991) investigated constraints of fertilizer use and learnt that higher cost of fertilizer ranked first followed by lack of guidance and unavailability of credit second and third, respectively.

Prasad and Pal (1991) studied on adoption of sorghum cultivation in dryland agriculture. Lack of credit, lack of knowledge, non palatability of fodder and low market value of grain were emerged as the major constraints.

Reddy (1991) concluded that lack of knowledge about incidence of pest and disease and their control were the main constraints in control of pest and disease. They also identified lack of knowledge about recommended dose of chemical fertilizers, lack of knowledge in seed treatment and lack of finance as the important constraints.

Tantray & Nanda (1991) identified the major constraints in increasing rice production in Kahmir valley as of economical nature, viz, high cost of cultivation, lack of profitable marketing system and inadequate credit facilities. Technological constraints constituted the third important category.

Gill and Singh (1992) listed out the constraints for non-adoption of recommended wheat production technology as lack of knowledge, lack of inputs and inadequate finance, etc.

Nandi, Gopal Krishna (1993) found that high cost of inputs, lack of finance, inadequate credit facilities, high cost of labour, lack of technological knowledge were the major constraints faced by the paddy growers.

Sherawat and Kharub (1993) summarized the constraints faced by the cotton growers as high cost of pesticides (77.7%), lack of knowledge about use of weedicides (97.7%), poor quality of insecticide (89.7%), lack of knowledge in plant protection measure (64.4%), lack of irrigation facilities (28.8%) and scarcity of labour (18.6).

Bhattacharjee (1994) reported that non availability of seeds of improved varieties was one of the reasons for poor productivity of oilseeds.

Dass (1996) found that high cost of farm inputs, adulteration in seeds, fertilizers and insecticides and low support price of the farm produce were most serious constraints pointed out by the farmers. Failure of crop due to unfavourable weather conditions was also serious constraints.

Nirmal Chandra *et al.*, (1996) observed that non-availability of improved seeds and lack of technical knowledge regarding package of practices in small land holdings were the major constraints for adapting soybean over a large area.

Devi and Manoharan (1998) had seen that among the market constraints low price for the produce (74.25%) was ranked as foremost constraint followed by lack of quick transport facilities (58.59%) and lack of storage practices (51.09%).

Satpal Singh (1999) found that major constraints related to input as per their rank order on the basis of its seriousness were 'high cost of inputs', 'non-availability of quality seeds', 'fertilizers, weedincides and pesticides at required time', 'inadequate credit facilities for purchasing inputs', 'non-availability of inputs at village level', etc. were main constraints as perceived by the farmers in the adoption of sunflower production technology.

Sube Singh (1999) found that 'non availability of quality spawn', 'high price of inputs', 'difficulty in compost making', 'low price of produce', 'lack of knowledge of current advances for mushroom cultivation' were found to be some of the major problems faced by the farmers in adoption of mushroom cultivation practices.

Jana (2000) reported that high cost of plant protection chemicals (56%) followed by lack of technical guidance (53%), more time consuming (29%) and adultration in chemicals (18%) were the main problems in the adoption of seed treatment.

2.8 Indigenous knowledge system of farmers

Knight (1980) suggested that the local innovations derived through local peoples' experience constituted the human intellectual "genepool", the basic raw material for adapting to the local environment. Systematic documentation of farmers traditional knowledge into an information bank, from which scientists, extension workers and other farmers can draw insights, has gained prominence in recent years.

Dover and Talbot (1987) also suggested that a productive and sustainable agriculture calls for a new view of agricultural development that builds upon the risk reducing, resource conserving aspects of traditional farming and draws on the advances of modern biology and technology.

Warren (1989) defined theoritised that indigenous knowledge system is local knowledge that is unique to a given culture or society. Each society has a variety of types of knowledge systems. Some deal with the natural and physical environment. Some with the cognitive and ideational environment, and other with the social environment. All these knowledge systems are coded in the local language and are passed down from generation to generation verbally.

Balasubramaniam (1992) documented 115 traditional beliefs covering various agricultural practices of rice farming in Coimbatore district of Tamilnadu.

Ulluwishewa (1992) documented the indigenous knowledge of traditional paddy farmers of Srilanka and reported that most practices used biological resources which were environmental friendly.

Pisharoty (1993) reported that farmers of Kerala planned the sowing dates of crop based on the flowering of a plant called “karmikarak” in Sanskrit. Flowering date of this plant is used to predict the onset of monsoon as early as 10th or 12th April. The normal date of onset of monsoon in Kerala is around first week of June and the meteorological department has no method to predict monsoons as early as April.

Preetha (1997) identified 80 indigenous practices and 20 indigenous believes related to rice cultivation of Thrissur district in Kerala. Most of these practices were judged as rationale by scientists.

Sundaram (1997) described seven indigenous practices followed by the cotton growers of TN. The reported practices were delineating the cotton seeds with cowdung, seed treatment with red earth, spray mix of sugar and neem oil, application of neem kernels, growing marigold as a fence crop, cultivating coriander as intercrop and digging small trenches to collect and destroy bollworm caterpillar.

CHAPTER - III

Methodology

The present chapter describes a detailed account of the methodological procedures and steps followed in conducting the study. The relevant information on methodological steps pertaining to the investigation has been given under the following sub-heads:

- 3.1 Locale of the study
 - 3.1.1 Selection of districts
 - 3.1.2 Selection of blocks
 - 3.1.3 Selection of villages
 - 3.1.4 Selection of respondents
- 3.2 Variables and their measurement
- 3.3 Constraints and their measurement
- 3.4 Identification of indigenous practices
- 3.5 Collection of data
- 3.6 Analytical procedures
- 3.7 Classification of respondents
- 3.8 Interpretation of results and report writing

3.1 LOCALE OF THE STUDY

The study was conducted in Haryana state, which is situated between 27° 39' to 30° 55' N latitude and 74° 27' 8" to 77° 36' 5" E longitude.

3.1.1 Selection of the Districts

The state of Haryana state comprises 19 districts. Thus, out of these, Kaithal and Karnal districts were purposively selected since these have maximum area as well as production of rice.

3.1.2 Selection of Blocks

From each selected district, two blocks were selected randomly. Therefore, Kaithal and Pundri Blocks of district Kaithal and Karnal I and Karnal II Blocks of district Karnal were selected randomly.

3.1.3 Selection of villages

A list of villages falling in each selected blocks was prepared separately with the help of extension functionaries of selected community development blocks. One village was selected randomly. Over all four villages namely Titram from block Kaithal, Pai from block Pundri, Chapparkhera from block Karnal I and Shahpur from block Karnal II were selected.

3.1.4 Selection of Respondents

A list of basmati paddy growers was prepared for each village and 50 farmers were selected randomly. Thus a total number of 200 respondents were selected as a sample for the study.

The extension personnel associated with transfer of technology formed the sample of extension personnel. In all 50 extension personnel were selected randomly for the purpose of study.

Locale of the research work

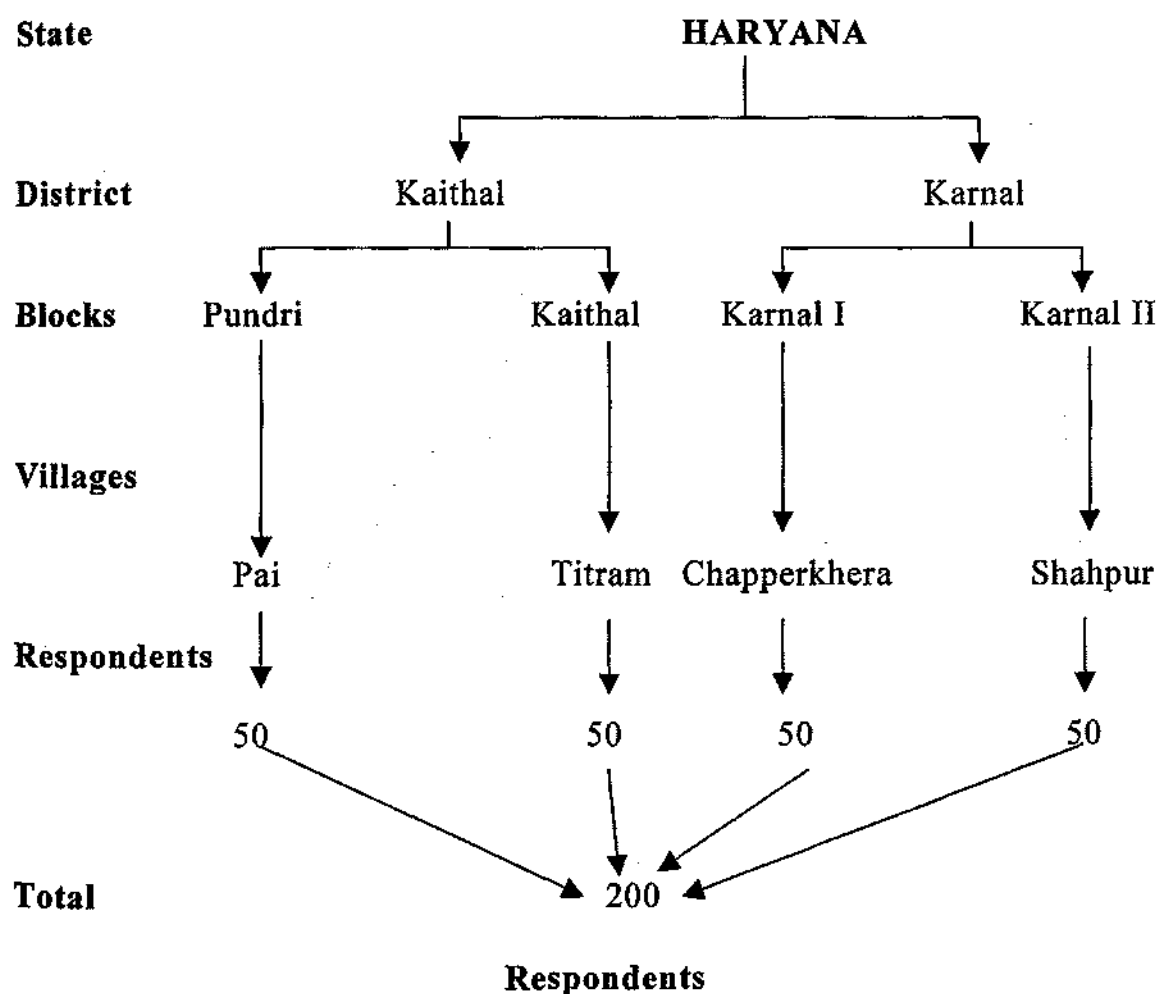


Fig. 1: Diagramatic representation of sampling plan

3.2 VARIABLES AND THEIR MEASUREMENT

A variable can be defined as a thing that is observed and that is of such a nature that each single observation can be defined into one and only one of a number of mutually exclusive classes (Kerlinger 1978).

3.2.1 Independent variable

Experiences and research evidences indicate that background characteristics of farmers play a significant role in accumulation of knowledge, shaping of attitudes and their level of adoption. Numerous factors influence the knowledge and attitudes of farmers. However, only those variables were selected for study, which were considered very significant, on the basis of findings of researcher in past.

(i) Age

Age of respondent was operationalized as the calendar years round off to nearest year, on the date of interview. One score was given for each complete year.

(ii) Education

Education is a level of literacy of farmers ranging from illiterate to educated upto college level. The scoring system suggested by Trivedi (1963) was used to quantify the educational status of the respondents, which is as below:

Education status/category	Score
Illiterate	0
Can read only	1
Can read and write	2
Primary	3
Middle	4
Matric	5
Graduate	6

(iii) Family education

Family education was taken into consideration instead of respondent's education alone. The reason being that if a respondent is not educated, other members of his family may be literate enough to read out the material to him, as reported by Singh and Nirwal (1974). For this study it was operationally defined as the formal education received by the members of respondent's family (above six years of age).

The level of family education was measured in terms of weighted mean family education score (WMFES) as developed by Singh and Nirwal (1974). The WMFES was based on pooled literacy status of all the members of a family. The WMFES was worked out through the following formula:

$$\text{WMFES} = \frac{\text{FES}}{n}$$

Where,

WMFES = Weighted mean family education score

FES = Summation of observed family education score

n = number of family members above six years age

(iv) Size of land holding

It refers to the acres of land possessed by the family. One score was given for each acre.

(v) Socio-economic status (SES)

It refers to the position of the respondent in the society, determined by various social economic variables viz. size of land holding, education, caste, occupation, number and type of houses, type and size of family, extent of social participation, strength of farm power and material possession and was measured by using the socio-economic status (SES) scale developed by Trivedi (1963) and is presented in Appendix I.

(vi) Social participation

It refers to the participation of the respondents in one or more organizations. It was measured with the help of socio-economic status scale of Trivedi (1963). Zero score was given to no participation and member of one organizations was awarded one score (less participation) and member of two or more organization was awarded with two scores (more participation).

(vii) Risk orientation

It is the degree to which a farmer is oriented towards risk and uncertainties and has a courage to face the problems in farming (Supe, 1969).

To measure the risk orientation of the respondents, scale developed by Supe (1969) was adopted and given in Appendix I.

(viii) Change Proneness

It is the disposition of a person to accept or reject change. This may be conceived as an individual's orientation in the continuum extending from the most acceptance of change to their sternest rejection (Moulik, 1965).

The change proneness was measured by using the self-rating scale, developed by Moulik (1965) given in Appendix I.

(ix) Mass media exposure

The mass media exposure has been operationalized as the degree to which the respondent was exposed to mass media (Radio, Television, Newspapers, Farm Magazines, Exhibition/Kisan melas) for obtaining information pertaining to agricultural technology. This was measured with the help of a schedule developed by Bhatti (1985), given in Appendix I.

(x) Extension contact

The extension contact has been operationalized as the degree to which the respondent was in contact with extension personnel. It refers to both acquaintance of respondents with extension personnel of different ranks and frequency of contact with them. It was measured with the help of

schedule developed by Bhatti (1985), given in Appendix I along with scoring plan.

(xi) Economic motivation

It is defined as the occupational success in terms of profit maximization and the relative value placed by a farmer on economic ends (Supe 1969).

It was measured by the self rating scale (Moulik, 1965) as given in Appendix I with its scoring plan.

3.2.2 Dependent variable

Attitude of farmers and extension personal towards concepts of sustainability as applied to rice cultivation, farmers' level of knowledge and adoption of sustainable rice production technology were taken as the dependent variables of the study.

A. Attitude

Overt behaviour is said to be the result of the attitude that people have (Chitambar, 1973). An attitude is a determining tendency, which predisposes a person to behave in certain ways towards objects, persons, ideas or values and situations in social environment.

Thurston (1946) defined attitude as the degree of positive or negative effect associated with some psychological objects. In the present

study, the psychological objects are agricultural practices against which farmers' agreement or disagreement was recorded.

Attitude may vary in their direction (i.e. may be positive, negative or neutral) their intensity (i.e. strongly agree, agree, neutral, disagree and strongly disagree) on the basis of its degree of importance attached to him.

In this study, the attitude scale developed by Berry (2000) was used to measure the attitude of the farmers and extension personnel towards concept of sustainability as applied to rice cultivation.

The scale consisted of positive and negative statements on a five point continuum. The respondents were asked to speak out their responses against its 18 statements on five point continuum.

Scoring procedure

Responses	For positive statements	For negative statements
Strongly agree	5	1
Agree	4	2
Undecided	3	3
Disagree	2	4
Strongly disagree	1	5

B. Knowledge

Knowledge is defined as those behaviours and test situations, which emphasized the remembering either, by recognition or recall of ideas, materials or phenomena.

Knowledge is a body of understood information possessed by an individual about a particular thing, act or process. It is one of the most important components of human behavior, which affect the covert, and overt behavior of human beings.

In the present study knowledge was operationalized as the information possessed by the farmers about the recommended sustainable practices of rice cultivation, which could be recalled through memory of ideas or events.

The existing knowledge was measured through knowledge schedule prepared on the basis of package of practices recommended by scientists of CCS HAU. Major technological components in relation to rice cultivation such as land preparation, improved seed, seed rate, seed treatment, time of sowing, spacing and depth of sowing, use of improved implements, application of manure, chemical and bio-fertilizers, weed management and plant protection technology were included in the knowledge schedule (Appendix I). The responses were obtained on a 3-point continuum, i.e. correct, partially correct and wrong or no knowledge ; and weights of 2, 1 and 0 were assigned, respectively. The scores were assigned practice-wise and then total score for each practice for each individual was worked out. The farmers were categorized into three categories of low, medium and high knowledge level on the basis of their knowledge score.

Adoption

The dictionary meaning of adoption is to take oneself by choice or approval, as policies, principles, opinions, a course of conduct etc. However, for the purpose of this study adoption has been operationalized as the continued use of recommended sustainable practices of rice cultivation.

An inventory of questions based on, discussion with scientist and recommended practices for sustainable rice cultivation was prepared and to the extent, a farmer adopt these recommendations, is his level of adoption.

Thus, there were six numbers of major areas, under each area the specific practices were identified to know their adoption by the respondents.

To estimate the adoption level, the farmers were asked about the actual use of each and every recommendation. The scoring was done as 2 for full adoption, 1 for partial adoption and zero for non-adoption.

In case, where there was no provision for partial adoption one score was assigned for adoption and zero for non-adoption.

The questionnaire, however, before administering to the respondents, was got checked by the scientists working in CCS HAU, the objective was to ensure that no major practices were left out from this questionnaire. The scores were assigned practice wise and then total score for each practices for each farmer was worked out. The farmers were categorized into three categories of low, medium and high adoption level on the basis of their adoption score.

3.3 CONSTRAINTS AND THEIR MEASUREMENT

According to Oxford English Dictionary, the constraints mean confinement, restriction of liberty or compulsion or circumstances or compulsion put upon the behavior. Constraints are the state or quality of source of being restricted to a given course of action.

For the purpose of this study, constraints refer to the situations or circumstances, which may impede, restrict or limit the acceptance of recommended rice cultivation. A list of common problems was prepared on the basis of review of literature and each respondent was asked to express his opinion about the seriousness of the problem, with respect to rice cultivation on three point continuum, i.e. 'very serious', 'serious' and 'not so serious'.

Construction of Interview Schedule

Detailed and simple structured interview schedule was constructed to measure various variables as per the objectives of the study. The schedule contained some background information relating to the socio-personal characteristics of the respondents, it also included the attitude scale, schedule to measure knowledge, adoption, to identify constraints and indigenous practices being followed by farmers, pertaining to rice cultivation.

3.4 IDENTIFICATION OF INDIGENOUS PRACTICES

Indigenous practices in rice were operationalized as those practices related to rice production from seed selection to harvest which were

followed in the system and transferred from generations that evolved as a result of traditions and experience rather than scientific research.

The task of identification of indigenous practices was accomplished by open ended questions on different farming practices in rice cultivation.

3.5 COLLECTION OF DATA

Data collection was done through personal interview technique. A well semi-structured interview schedule (Appendix-I) was prepared which contained questions covering all the aspects as per the objectives of the study. The first part consists of background information about the respondents, i.e. the independent variables selected for the study viz., age, socio-economic status (caste, education, house land holding, family type, family size, material possession, farm power and social participation) family education, land holding, extension contact, mass media exposure, change proneness risk orientation and economic motivation. The second part consisted of attitude scale to measure attitude about concept of sustainability as applied to rice cultivation. Third and fourth part consisted of knowledge and adoption schedule to measure level of knowledge and adoption of farmers about sustainable practices of rice cultivation. The fifth part devoted to ascertain the constraints in adoption of sustainable practices of rice cultivation. Indigenous practices were identified by open ended questions on different farming practices in rice cultivation.

3.6 ANALYTICAL PROCEDURES

The data collected were transmitted on the master sheets indicating various aspects of the phenomena and were put to statistical analysis. Frequency distribution, percentages, means, standard deviation, coefficient of variance, correlation coefficient etc. were worked out for the purpose of analysis and interpretation of data.

3.7 CLASSIFICATION OF RESPONDENTS

The mean, standard deviation and frequency distribution techniques were used for classification of respondents into different categories. The respondents were classified into three categories on the basis of their age, education, family education, socio-economic status, extension contact, mass media exposure, economic motivation, risk orientation, change proneness and level of knowledge and adoption.

3.8 INTERPRETATION OF RESULTS AND REPORT WRITING

Based on the findings of the study inferences were drawn on the basis of statistical analysis. The results were interpreted and recorded keeping in view the objectives of the study.

CHAPTER – IV

Results and Discussion

The findings of the study, derived through the use of prescribed methodology and standard tools as mentioned earlier, have been presented in this chapter. The results elicited after statistical analysis have been interpreted and discussed. Each section provides a detailed account of the finding and have been suitably discussed giving relevant references at appropriate places. The findings have been presented as follows:

- 4.1 Profile of respondents.
- 4.2 Attitude of farmers and extension personnel towards sustainability as applied to rice cultivation.
- 4.3 Association between farmers' personality traits and their knowledge level of sustainable rice cultivation technology.
- 4.4 Association between farmers' personality traits and their adoption level of sustainable rice cultivation technology.
- 4.5 Constraints in adoption of sustainable rice cultivation practices.
- 4.6 Indigenous practices followed by farmers.

4.1 Profile of the Respondents:

The distribution of the respondents based on their socio-personal traits is being presented in Table 1. The trait wise profile is given below:

4.1.1 Age

The data in Table 1 reveals that more than half of the respondents (57%) were above 35 years of age. The mean age of the sample is also 41.93 years which indicates that the farmers were of middle age group. However, a considerable number of them (29%) were also upto 35 years. Only fourteen per cent farmers were above 51 years. The standard deviation (S.D.) (12.03) value indicates that there was some variation among the respondents with respect of their age.

4.1.2 Land holding

Table 1 indicated that a large number of the respondents (58%) were medium farmers having 5.1 to 10 acres of land followed by small farmers (23%) having 2.6 to 5 acres of land. There were few marginal farmers (6.5%) having less than 2.5 acres of land. Only 12.5 per cent of the respondents were having more than 10 acres of land holding. Zone wise distribution of land holding was almost same in all the categories of farmers. Sample mean was 6.8, which shows that the respondents possessed medium size holding. Standard deviation of the sample is 4.7, which indicates moderate variation in size of holding owned by the respondents.

Table 1: Profile of the respondents

Sr. No.	Socio-personal traits	Category	Number of respondents in percentage			Mean	SD
			Zone-I (n=100)	Zone-II (n=100)	Total (n=200)		
1.	Age	Young (upto 35 years)	20	38	29	41.93	12.03
		Middle (36-50 yrs.)	68	46	57		
		Old (51 yrs. And above)	12	16	14		
2.	Education	Illiterate	5	15	10	3.88	1.49
		Up to primary	35	25	30		
		More than primary and up to middle	41	43	42		
		More than middle and upto matric	13	9	11		
		Above matriculation	6	8	7		
3.	Land holding	Marginal (below 2.5 acres)	6	7	6.5	6.8	4.7
		Small (2.6 to 5.0 acres)	22	24	23		

		Medium (5.1-10.0 acres)	60	56	58		
4.	Socio-economic	Large (above 10 acres)	12	13	12.5		
		Low (0-18)	14	11	12.5	28.82	7.27
		Medium (19-36)	77	82	79.5		
		High (37-54)	9	7	8		
5.	Social participation	Non participant	63	57	60	0.42	0.31
		Participant	37	43	40		
6.	Family education	Low (0-2.0)	42	53	47.5	2.96	1.41
		Medium (2.1-4.0)	48	39	43.5		
		High (4.1-6.0)	10	8	9		
7.	Extension contact	Low (0-7)	66	78	72	5.63	6.23
		Medium (8-14)	28	13	20.5		
		High (15-21)	6	9	7.5		

8.	Mass media exposure	Low (0-6)	14	21	17.5	9.01	5.29
		Medium (7-12)	73	69	71		
		High (13-18)	13	10	11.5		
9.	Risk orientation	Low (<18)	14	16	15	22.7	7.11
		Medium (18 to 29)	82	72	77		
		High (>29)	4	12	8		
10.	Economic Motivation	Low (<12)	2	4	3	13.01	2.83
		Medium (12-15)	68	80	74		
		High (>15)	30	16	23		
11.	Change proneness	Low (<15)	10	16	13	13.83	2.96
		Medium (12-15)	86	79	82.5		
		High (>15)	4	5	4.5		

4.1.3 Socio-economic status (SES)

It is seen from Table 1 that 79.5 per cent of the respondents had a medium socio-economic status, followed by 12.5 per cent having low level of SES. Only 8 per cent of the respondents had high SES. No significant difference in SES was observed between the two zones. However, mean SES score was 28.82 indicates that on an average farmers in the sample had a medium level of socio-economic status.

4.1.4 Education

Table 1 shows that majority of the respondents (42%) possess middle level of education followed by primary level (30%). The data indicates that 90 per cent of the respondents were literate. Only 10 per cent of the respondents were illiterate. The illiteracy was higher in zone-II (15%) than in zone-I (5%). Overall 18 per cent of respondents were having more than middle level of education. There was no marked differences between the two zones in this respect. The mean education score 3.88 indicates that on an average the respondents had medium level of education.

4.1.5 Family education

The data in table 1 opines that 91 per cent respondents had low to medium level of family education. There were only 9 percent respondents who had high level of family education. The mean score (2.96) also shows that on an average the sample had moderate level of family education. Zone

wise also there is not much difference as for as their family education level is concerned.

4.1.6 Social participation

A perusal of Table 1 concludes that 40 per cent of the respondents were either members or office bearers in social organizational activities. Whereas more than half of the respondents (60%) were not associated with any organization. Zone wise also the trend was found almost same. The mean score (0.42) with SD 0.31, also indicates low participation of respondents in social activities.

4.1.7 Extension Contact

It was observed that about three fourth (72%) of the respondents had low level of extension contact. The percentage of respondents having medium level of extension contact was more in zone-I (28%) than zone-II (13%). Only 7.5 per cent of the respondents had high level of extension contact, where as 20.5 per cent of respondents had medium level of extension contact. The mean score (5.63) also indicates that on an average the respondents had low level of extension contact.

4.1.8 Mass media exposure

Perusal of the data opined that 71.00 per cent farmers had medium level of mass media exposure followed by low level of mass media exposure (17.50%). Only 11.5 per cent of the farmers had high exposure to mass media, when considered zone wise, there was no significant difference

between them regarding their level of mass media exposure. Mean score (9.01) also indicates the low level of mass media exposure of farmers.

4.1.9 Change proneness

The table 1 shows that 82.50 per cent of the respondents possessed medium level of change proneness, followed by low level of change proneness (13.00%). Only a few farmers (4.50%) possessed a high level of change proneness. In zone I, 86 per cent and 10 per cent and in zone II 79 per cent and 16 per cent farmers had medium and low level of change proneness. An equal number of farmers were found to have high level of change proneness, though their number is very small. The mean score (13.86) indicates that on an average the farmers possessed a medium level of change proneness.

4.1.10 Economic Motivation

Almost two-third of the respondents (74.00%) belonged to medium level of economic motivation, followed by 23.00 per cent of respondents possessing high level of economic motivation, only three per cent respondents found to have low economic motivation category. When compared zone wise the data revealed that in case of zone-I, 30.00 per cent of respondents had high level of economic motivation, whereas in case of zone-II only 16.00 per cent belonged to high level of economic motivation class. The mean and SD of the sample was 13.01 and 2.83 respectively.

4.1.11 Risk orientation

It was observed that about two-third (77%) farmers had medium level of risk orientation, whereas 15 per cent fall under low and only 8 per cent belonged to high level of risk orientation. When farmers of zone-I and zone-II were compared no remarkable differences existed. Mean and SD of the group were 22.7 and 7.11 respectively, meaning thereby the medium level of risk orientation of the respondents on the whole.

4.2 Attitude of farmers and extension personnel towards sustainability

An attempt was made to analyse attitude of farmers and extension personnel about the issue of sustainability as applied to the rice cultivation belt of Haryana.

4.2.1 Farmers' attitude towards sustainability

An attitude could be viewed as a predisposition for an individual to act in a certain way in a given situation. So attitude of farmers towards sustainability has profound implication in integrating the goal of environmental conservation with production.

The farmers were categorized into few classes of attitude level ranging from highly unfavourable to highly favourable. Table 2 reveals that the mean attitude score of farmers towards sustainability was 53.51 which indicates a neutral attitude. It indicates that the farmers are not fully convinced about sustainability. In all 43 per cent farmers had either favourable or highly favourable attitude towards sustainability and only 9 per



Table 2: Distribution of farmers and extension personnel attitude towards sustainability as applied to rice cultivation

Attitude level	Range of attitude score	Frequency (in percent)	
		Framers (n = 200)	Ext. Personnel (n = 50)
Highly unfavorable	18.0-32.4	3	0
Unfavorable	32.5-46.8	6	4
Neutral	46.9-61.2	48	33
Favorable	61.3-75.6	39	46
Highly favorable	75.7-90.0	4	17
Farmers' mean score	= 53.51	SD = 8.17	CV = 15.27
Extension personnel' mean score	= 67.32	SD = 7.50	CV = 11.14

cent were not having a favourable attitude towards sustainability as applied to rice cultivation. Therefore, the constituency for extreme conservation farming strategies like organic farming is really limited and is confined to this four per cent. There were few (three per cent) who had highly unfavourable attitude towards sustainability. In fact almost half of the farmers (48%) had their level of attitude at and around the mid point of the scale. This suggests that there is continuing ambiguity about the concept among farmers, which prevents them from polarising their attitude clearly. Therefore, extension organizations should take measures to educate and convince the farmers about the prospects of sustainability.

4.2.2 Extension personnel' attitude towards sustainability

Extension personnel play a key role in influencing the attitude of farmers towards the concept of sustainability. So, it is important to know how they themselves view this concept.

Table 2 shows the distribution of extension personnel on attitude towards sustainability. Majority of extension personnel (63%) were having favourable and highly favourable attitude towards sustainability. None of the extension personnel showed highly unfavourable attitude towards sustainability. Only four per cent showed unfavourableness towards the concept, one third of extension personnel (33.00%) were neutral. On an average the extension personnel had a moderately favourable attitude towards sustainability as the mean score of extension personnel is 67.32 per

cent. So, being an area of tremendous debate, majority might have perceived the importance of sustainable agriculture.

4.2.3 Response of farmers on different components of attitude scale

An attempt was made to analyse the response of farmers on different components of attitude scale.

As seen from Table 3 incase of 'natural resource conservation' component majority of farmers (66%) falls in 'agree' category whereas in case of 'farming efficiency' and 'profitability' component about half of farmers (50% and 52% respectively) lie in 'agree' category, but only 46.00 per cent farmers lie in 'agree' category in case of farming efficiency component. It indicates farmers' attitude was more favourable in relation to these items which were related to 'natural resources conservation' component, it was lowest level of agreement in relation to those items which were related to 'high input use and related problems' component. Same was the case for 'profitability' and farming efficiency' components. This could be attributed to general misconception that sustainable agriculture resulted in lower production and economic returns (Pretty 1996) and was in conformity with the results of Beus and Dunlap (1994) and Berry (2000).

On the items related to 'natural resource conservation' majority of farmers had an attitudinal disposition in favour of sustainable agriculture. In fact these dimensions had direct impact on their lives and surrounding and they were experiencing the hazards of environmental degradation. So they

Table 3: Farmers' response on different components of attitude towards sustainability.

Sr. No.	Components	Level of agreement in percentage		
		Agree	Undecided	Disagree
I	Natural resources conservation	66	8	26
II	High input use and related problems	46	7	47
III	Farming efficiency	50	12	38
IV	Profitability	52	11	37
	Overall	53.5	9.5	37

favoured sustainable agriculture on these dimensions as an alternative to conventional agriculture.

In case of 'high input use and related problems', it seemed that the majority of the farmers were not convinced about the potential of substitutes of high inputs use in actual farming situations. For instance the non availability of organic manures in required quantities might be the major reason for the farmers to take this pragmatic attitudinal position on few items of scale.

The results of farmer's response on different components of attitude towards sustainability scale were in conformity with the results of Beus and Dunlap (1991) and Berry (2000).

4.2.4 Response of extension personnel on different components of attitude scale

To had a better insight into the divergence of extension personnel on various components of attitude scale, the component wise analysis has been presented in Table 4. The results indicate a trend in favour of sustainability on three components, namely, 'high input use and related problems' 'natural resources conservation' and 'farming efficiency'. Though in case of 'profitability' component it was moderate. It remained obvious that their professional curriculum training spurred them to develop such an attitude on these profitability related items. Similar results were obtained by Beus and Dunlap (1991) and Berry (2000).

Table 4: Extension personnel' responses on different components of attitude towards sustainability.

Sr. No.	Components	Level of agreement in percentage		
		Agree	Undecided	Disagree
I	Natural resources of conservation	66	5	29
II	High input use and related problems	83	3	14
III	Farming efficiency	62	12	26
IV	Profitability	50	8	42
	Overall	65.25	7	27.75

4.2.5 Attitude of farmers towards sustainability as applied to rice cultivation and it's association with their background variables.

Correlation coefficient was worked out to know the association of farmers' background variables, viz. age, land holding, socio-economic status, education, social participation, family education, risk orientation, economic motivation, mass media exposure, extension contact, and change proneness with their attitude towards sustainability as applied to rice cultivation.

Table 5 reveals that the educational status of the respondents and their family education had a significant positive relationship with attitude. This is quite logical as education has a positive influence on knowledge, attitude and skills of the individual, land holding, socio-economic status and social participation also had a significant and positive relationship as these provide capability to individual for access to information, hence results in development of favorable attitude towards new scientific concepts like sustainability.

Similarly, economic motivation, mass media exposure and change proneness also had a significant and positive correlation with attitude, which seems to be logical. Age, risk orientation and extension contact, had no significant relation with attitude. It may be due to that lower age group had lost score on 'natural resources conservation' component of attitude scale as it is more confined to profit of present day where as older age group having

Table 5: Correlation between farmer's attitude towards sustainability as applied to rice cultivation and their background variables.

Sr. No.	Variables	Correlation coefficient
1	Age	0.086
2	Land holding	0.233**
3	Socio-economic status	0.278**
4	Education	0.356**
5	Social participation	0.174*
6	Family education	0.233**
7	Risk orientation	0.039
8	Economic motivation	0.143*
9	Mass media exposure	0.297**
10	Extension contact	0.138
11	Change proneness	0.317**

* Significant at five per cent level of significance

** Significant at one per cent level of significance

low education had scored more on 'natural resources conservation' component as they are better acquainted with ecological positives of ecofriendly sustainable organic low input farming.

Risk orientation and extension contact had positive but non-significant correlation, might due to the fact that score of overall respondents sample was low on these variables.

4.3 Association between farmers' personality traits and their knowledge level of sustainable rice cultivation technology

The knowledge of the farmers about different rice cultivation is an indication of their agricultural progressiveness. Here, it refer to the information possessed by the farmers about various major technological components in accordance with the recommendations of practices for rice cultivation.

Knowledge plays an important role in decision making process (Rogers and Hawen, 1961). It is the precursor to the adoption of any innovation. It might by difficult to presume the level of adoption of a technology unless it is first known to the person who is going to adopt it.

Goldstein and Eichhorn (1961) contended that knowledge influences the intellect phases of human behaviour producing both favourable and unfavourable responses. They further observed that over adoption also occurs due to insufficient and incorrect knowledge of the innovations.

Rogers and Shoemaker (1971) categorized knowledge into three components:

- (i) “awareness knowledge” which refers to the information that the innovations exist.
- (ii) “how to knowledge” which refers the information needed to use an innovation properly” and
- (iii) “principle knowledge” which comprises the functioning principles underlying the innovation.

Generally a person with high technical knowledge about an improved agricultural practices will show an higher inclination towards adoption probably because knowledge is not static. Once knowledge is acquired and accumulated in the minds of farmers, it brings about radical changes in thinking process. As a consequence of active functioning, knowledge leads to a further change in the mental outlook of the farmers by adopting the improved technology. Thus, it has been considered as a prerequisite for action.

The present investigation had made an endeavour to ascertain the knowledge level of farmers with regard to the rice cultivation technology recommended by the scientists.

4.3.1 Distribution of farmers in different categories based on knowledge level of sustainable rice cultivation technology

Table 6 shows that the knowledge score of the farmers ranged from 18 to 68 having mean knowledge score of 47.37 against maximum possible knowledge score of 75. In terms of percentage, the mean score was 63.16 which means that farmers' knowledge was of good level, standard deviation (S.D.) of the sample was 12.03 and Coefficient of variation (CV) was 25.41 which implies that there was some what variation among them with respect to their knowledge level.

The farmers were further classified into three different categories namely, 'low', 'medium' and 'high' on the basis of their knowledge score. Their distribution is given in Table 6. The Table reveals that majority (51.00%) of the respondents possessed medium level of knowledge. The percentage of farmers under high knowledge category was 45. Which is also quite high. It is thus clear that more than 90.00 percent of the farmers has medium to high level of knowledge. Only 4 percent of the respondents fell under the low knowledge level category. Sharma (1986) also found that maximum percentage of respondents carried medium level of knowledge of recommended agricultural practices. Lack of knowledge of the package of practices had been a major handicap to the farmers. Hence, it is necessary that the extension workers should make more efforts to educate farmers about rice cultivation technology. Mathur (1970) also reported that final decision of

Table 6: Distribution of farmers in different categories based on their knowledge level of sustainable rice cultivation technology

(n=200)

Sr. No.	Knowledge level	Score range	Frequency of respondents	Percentage of respondents
1	Low	0-25	8	4
2	Medium	26-50	102	51
3	High	51-75	45	45
mean = 47.37		SD = 12.036	CV = 25.41	

farmers to use a new practice is usually the result of their knowledge of the practice.

4.3.2 Knowledge level of farmers on major aspects of sustainable rice cultivation technology:

It was presumed that the knowledge of farmers might not be uniform on all the aspects of sustainable rice cultivation technology (SRCT). All the practices were, therefore, grouped into six major categories to see the variation in knowledge on different aspects of SRCT.

Aspect wise knowledge of farmers expressed in terms of mean and percentage is presented in Table 7. The table shows that the knowledge level about variety, agronomic practices, weed control, fertilizer application, plant protection, were of high order i.e., 82.83, 65.52, 68.50, 74.25, 60.90 respectively, while it was comparatively low in case of nursery preparation and management. Though, the extension workers have to pay attention in educating the farmers about all the aspects of rice cultivation but they need to make more efforts to educate the farmers about nursery preparation and management.

The findings of the study are supported by Sharma (1986) and Nikhade *et al.* (1990)

Table 7: Knowledge level of farmers' on major aspects of sustainable rice cultivation technology

Sr. No.	Aspect	Maximum possible score	Mean knowledge score	Mean score expressed as percentage of max. score
1	Varieties	6	4.97	82.83
2	Nursery preparation and management	28	14.89	53.17
3	Agronomic practices	17	11.14	65.52
4	Weed control	2	1.37	68.50
5	Fertilizer application	12	8.91	74.25
6	Plant protection	10	6.09	60.90
7	Overall	75	47.37	63.16

4.3.3 Correlation between farmers' level of knowledge and their background variables

Correlation coefficient was worked out to know the relationship between farmers' background variable, viz. Age. Land holding, socio-economic status, education, social, participation, family education, risk orientation, economic motivation, mass media exposure, extension contact, change proneness, attitude and their knowledge score. The results are presented in Table 8.

The correlation analysis revealed that the age of the respondents had a negative but non-significant relationship with knowledge level of farmers. It is quite logical as older people are likely to more conservative where as young people are more interested to acquire new ideas and knowledge.

The educational status of the respondents and their family education had a significant positive relationship with knowledge (at one per cent level of significance). This is also quite logical as education has a positive influence on knowledge. Land holding, socio-economic status, economic motivation, change proneness and attitude of the respondents also showed a positive and significant relationship with their knowledge level on SRCT. This shows that these variables play an important role in acquiring knowledge about sustainable rice cultivation practices.

Table 8: Correlation between farmers' level of knowledge and their background variables.

Sr. No.	Variables	Correlation coefficient
1	Age	-0.087
2	Land holding	0.306**
3	Socio-economic status	0.345**
4	Education	0.225**
5	Social participation	0.013
6	Family education	0.167*
7	Risk orientation	0.043
8	Economic motivation	0.457**
9	Mass media exposure	0.047
10	Extension contact	0.103
11	Change proneness	0.374**
12	Attitude	0.343**

* Significant at five per cent level of significance

** Significant at one per cent level of significance

However, positive but non-significant relationship was found between the respondents' knowledge with social participation, risk orientation, mass media exposure and extension contact. It may be due to low score of respondents on these variables.

The findings of the study are in consonance with the reports of Sharma (1986), Baadgaonkar (1983), Mundhva and Patel (1987). Reddy and Reddy (1987), Kher and Halyal (1988), Bhatia (1991) and Kumar (1992).

4.4 Association between farmers' personality traits and their adoption level of sustainable rice cultivation technology

4.4.1 Distribution of farmers in different categories based on their adoption level of sustainable rice cultivation technology

Acceptance of recommended technology for sustainable rice cultivation varies from individual to individual and aspect-wise also. An endeavour has been made in the present study to determine the adoption level of sustainable rice cultivation technology. The findings are presented as under:

The Table 9 shows that adoption score of the farmers ranged from 11 to 41 having mean adoption score of 25.08 against maximum possible adoption score of 45. It reveals that the farmers on an average had medium adoption level of sustainable rice cultivation technology.

The samples' standard deviation is 6.33 and coefficient of variation is 25.24 per cent, which indicate that the sample is considerably

Table 9: Distribution of farmers in different categories based on their adoption level of sustainable rice cultivation technology

(n=200)

Sr. No.	Adoption level	Score range	Frequency of respondents	Percentage of respondents
1	Low	0-15	4	2
2	Medium	16-30	146	73
3	High	31-45	50	25
mean = 25.08		SD = 6.33	CV = 25.24	

homogeneous, and there is no wide variation among farmers with respect to their adoption level.

A classification of the respondents has been made namely, 'low' 'medium' and 'high' on the basis of their level of adoption as shown in Table 9.

The perusal of Table 9 shows that most of the respondents (73.00%) belonged to the medium level of adoption category. It is further noted that 25 per cent of the respondents fell under the 'high' category obtaining adoption score of 31 or more. However, only two percent of the respondents were under the low level of adoption category. Thus it is obvious that more than 90 percent of the farmers had medium to high level of adoption about SRCT.

These findings are in consonance with the reports of Goyal (1990), Singh and Sharma (1990) and Sherawat and Kharub (1993) who have also reported medium level of adoption of recommended practices in other crops in their studies.

4.4.2 Adoption level of farmers on major aspects of sustainable rice cultivation technology

It was felt that adoption of farmers might not be uniform on all the aspects of SRCT. All the component practices were further classified into six categories to see if there is any variation in the adoption level on different aspects of sustainable rice cultivation technology.

Aspect wise adoption level of farmers expressed in terms of mean score as well as in terms of percentage of maximum possible score. The Table 10 reveals that the adoption level was highest (71.42%) in case of agronomic practices. Kumar (1992) and Verma (1985) had also reported high level of adoption of agronomic practices in other crops also.

The adoption of fertilizer application (60.58%) and weed control (58.66%) was comparatively high, while adoption of nursery preparation and management (49.63%) and variety (46.50%) was medium. Singh (1984) and Bhatia (1991) also reported the similar findings in their studies.

Singh and Sharma (1988) and Singh (1984) also observed that majority of the farmers did not follow the ideal method of nursery preparation and management. Patil (1982) reported that majority of the farmers (63.02%) used higher seed rate in rice. He also observed that majority of the farmers (60.94%) did not treat their seed at all.

The level of adoption in plant protection measure was to the turn of (46.62%) which was also lower. Agarwal (1984), Bhatia (1991) also reported low adoption level of plant protection measures. The study suggests that extension workers should make more intensive efforts to motivate and educate the farmers about plant protection measures, nursery preparation and management practices and improved varieties.

Table 10: Adoption level of farmer's on major aspects of sustainable rice cultivation technology

Sr. No.	Aspect	Maximum possible score	Mean adoption score	Mean score expressed as percentage of max. score
1	Varieties	4	1.86	46.50
2	Nursery preparation and management	11	5.46	49.63
3	Agronomic practices	7	5.00	71.42
4	Weed control	3	1.76	58.66
5	Fertilizer application	12	7.27	60.58
6	Plant protection	8	3.73	46.62
7	Overall	45	25.08	55.73

4.4.3 Correlation between farmers' level of adoption of sustainable rice cultivation technology and their background variables

To have an idea about the relationship between farmers' background variables and their level of adoption of sustainable rice cultivation technology, correlation coefficient were calculated as presented in Table 11.

The table 11 shows that age of the respondents was non-significant and negatively correlated with adoption. Salunkhe (1984) and Jagtap (1985) reported similar findings. Kumar (1992) and Bhatia (1991) also presented similar views.

Other background variables namely land holding, socio-economic status, education, family education, economic motivation, change proneness, knowledge, attitude were found to have positive and significant relationship with adoption.

Singh and Rajendra (1990), Bavalatti and Sundaraswami (1990), Singh and Sharma (1990), Juliana *et al.* (1991) and many other research workers found significant relationship between education, family education, socio-economic status, land holding and change proneness with adoption. Kumar (1992) observed a positive and significant relationship between family education, economic motivation and knowledge with adoption.

Ferreira *et al.* (1989), Salunkhe (1984), Igodan *et al.*, (1988) and Supe *et al.* (1990) reported a positive and significant relationship of education

Table 11: Correlation between farmers' level of adoption of sustainable rice cultivation technology and their background variables.

Sr. No.	Variables	Correlation coefficient
1	Age	-0.094
2	Land holding	0.325**
3	Socio-economic status	0.267**
4	Education	0.277**
5	Social participation	0.085
6	Family education	0.158*
7	Risk orientation	0.132
8	Economic motivation	0.601**
9	Mass media exposure	0.080
10	Extension contact	0.022
11	Change proneness	0.259**
12	Knowledge	0.272**
13	Attitude	0.296**

* Significant at five per cent level of significance

** Significant at one per cent level of significance

family education land holding and change proneness with adoption.

Singh and Rajendra (1990), Supe *et al.* (1990), Singh and Sharma (1990), Chaudhari and Makode (1992) and many other research workers found a positive and significant association between socio-economic status and adoption.

Salunkle (1984), Jagtap (1985), Reddy *et al.* (1987) and Singh and Sharma (1990) found a significant relationship of attitude of the farmers with adoption.

4.5 Constraints in adoption of sustainable rice production technology

An endeavour was made to find out the constraints in the adoption of package of practices for sustainable rice cultivation. The farmers were asked to enumerate the reasons for non-adoption or partial adoption of the recommended sustainable practices for paddy cultivation. The problems felt by the respondents in the adoption were listed and then classified into four major areas as below:

- A. Constraints pertaining to inputs
- B. Constraints pertaining to production process
- C. Constraints pertaining to marketing
- D. Constraints pertaining to technical knowledge

The list of constraints along with average score and their degree of seriousness have been presented in Table 12.

Table 12: Constraints in adoption of sustainable rice cultivation practices.

S.No.	Constraints	Av. Score	Degree of seriousness
A. Inputs			
1	Complicated credit procedure	2.63	VS
2	High cost of fertilizer	2.20	VS
3	Lack of finance for purchase of inputs	2.16	VS
4	High cost of insecticides, fungicides and weedicides	2.04	VS
5	Non availability of bio-fertilizers	1.92	S
6	Non availability of weedicide and pesticide	1.76	S
7	Non-availability of biological material for pest control	1.52	S
8	Lack of guidance for availing credit facilities	1.43	S
9	High cost of good quality seed	1.28	S
10	Non availability of quality seed	0.72	NSS
11	Non availability of chemical fertilizers	0.53	NSS
12	Inadequate credit facilities for purchase of inputs	0.43	NSS
B. Production process			
1	High cost of labour	2.0	VS
2	Non availability of skilled labour in time	1.28	S
3	Difficulty in draining away excessive water from the field	0.48	NSS
4	Lack of irrigation facilities	0.36	NSS

c. Marketing

1	Lack of remunerative prices	2.26	VS
2	Distress sale due to immediate need of money	0.68	NSS
3	Inadequate procurement through Govt./ Semi-Govt. Agencies	0.48	NSS

d. Technical knowledge

1	Lack of knowledge about bio-fertilizers	2.19	VS
2	Lack of knowledge for application of insecticides and fungicides	1.56	S
3	Lack of knowledge about biological control of insects/diseases	1.48	S
4	Lack of technical knowledge for seed treatment	1.48	S
5	Lack of knowledge for application of weedicides	1.20	S
6	Lack of technical knowledge for seedling treatment	0.92	NSS
7	Lack of knowledge for application of fertilizers in the nursery bed and main field	0.52	NSS
8	Lack of knowledge of high yielding varieties	0.20	NSS

VS = Very serious;

S = Serious;

NSS = Not so serious

Constraints pertaining to inputs

Table 12 shows that complicated credit procedure (2.63), high cost of fertilizer (2.20), lack of finance for purchase of inputs (2.16), high cost of insecticides, fungicides and weedicides (2.04), were the constraints pertaining to inputs which the respondents considered as of very serious nature.

Where as the constraints like, non availability of bio-fertilizer (1.92), non-availability of weedicide and pesticides at the required time (1.76), non availability of biological material for pest control (1.52), lack of guidance for availing credit facilities (1.43), high cost of good quality seed (1.28), were considered as constraints of serious nature by the respondents. Where as constraints like non availability of quality seed (0.72), non-availability of chemical fertilizer (0.53) and in adequate credit facilities for purchase of inputs (0.43) were perceived as not so serious by the farmers.

Sherawat and Kharub (1993), Lakhera and Panjabi (1991), Tantray and Nanda (1991), Nikhade and Bhople (1989) also reported similar findings. Misra (1990) concluded that steep rise in the cost of agricultural inputs had made farming almost un-economical. Chowdhary and Dasgupta (1989) and Shenoï and Mandal (1986) also described financial limitation as major constraint in the adoption of improved agricultural practices. Laharia and Bhatti (1991) pointed out economic constraint as important one in the adoption of biogas technology in rural areas.

B. Constraints pertaining to production process

Farmers considered high cost of labour (2.0) as constraint of very serious nature, whereas, non-availability of skilled labour in time (1.28) was considered as constraint of serious nature. Other constraints related to production process like difficulty in draining away excessive water from the field (0.48) and 'lack of irrigation facilities' (0.36) were considered as constraints of not so serious nature.

Singh and Sharma (1986) also mentioned high cost of farm labourer and non-availability of labour as major constraints in adoption of paddy production technology. Rane (1989) pointed out shortage of labour as one of the important constraint. Bhatol (1987) also reported similar findings.

C. Constraints pertaining to marketing

As regards the constraints relating to marketing, the respondents reported 'lack of remunerative prices' (2.26) as a very serious constraint where as 'distress sale due to immediate need of money' (0.68) and 'inadequate procurement through Govt./semi-govt. agencies' (0.48) were reported as constraints of not so serious nature.

Tantray and Nanda (1991) also concluded that lack of profitable marketing system was one of the most important constraints in increasing rice production. 'Low price of the produce' was identified as a major constraint also by Bhatol (1987).

D. Constraints pertaining to technical knowledge

In respect of technical constants, 'lack of knowledge about biofertilizers' (2.19) was reported as very serious constraint by the respondents.

'Lack of proper knowledge for application of insecticides and fungicides' (1.56), 'lack of knowledge about biological control of insect/disease' (1.48) 'lack of technical knowledge for seed treatment' (1.48), 'lack of knowledge for application of weedicides' (1.20) were perceived as serious constraints by the respondents.

Where as constraints like 'lack of technical knowledge for seedling treatment' (0.92) 'lack of knowledge for application of fertilizers in the nursery bed and main field' (0.52) and 'lack of knowledge of high yielding varieties' (0.20) were perceived, as constraints of not so serious nature by the respondents.

The findings are in conformity with the studies conducted by, Girase and Kamble (1991), Bhoite and Dusane (1990), Srivastava and Singh (1990), Nikhade and Bhople (1989) and Wagmare and Pandit (1982).

Thus it is seen that high cost of inputs, lack of capital, high cost of labour, lack of remunerative prices for the produce, lack of knowledge about pesticides/weedicides/biological control of insect/diseases are the major constraints of the farmers.

An intensive efforts by the extension agencies can solve the technical problems by organizing training programme as per the convenience of the farmers, conducting demonstrations on the related aspects and also by distributing the relevant literature to the farmers. The government can play an important role in removing the constraints pertaining to inputs, production and marketing through proper policy.

4.6 Indigenous practices followed by farmers

Warren (1989) defined that 'indigenous knowledge system is local knowledge that is unique to a given culture or society'. Each society has a variety of types of knowledge systems. Some deal with the natural and physical environment. Some with the cognitive and ideational environment and other with the social environment. All these knowledge systems are coded in the local language and are passed down from generation to generation verbally.

Knight (1980) defined that the indigenous knowledge (local innovations) derived through local peoples' experience constituted the human intellectual "genepool", the basic raw material for adapting to the local environment. Systematic documentation of farmers traditional knowledge into an information bank has gained prominence in recent years from it scientists, extension workers and other farmers can draw insights.

Dover and Talbot (1987) also suggested that a productive and sustainable agriculture calls for a new view of agricultural development that

builds upon the risk reducing, resource conserving aspects of traditional farming and draws on the advances of modern biology and technology.

In the present study, eight indigenous practices were identified, which were being followed by respondents of the sample. The practices are listed in Table 13. In order of their prevalence in the area. Summer ploughing was being followed by 193 respondents (N=200). Summer ploughing is practiced after rabi crop i.e. during month of May. The farmers generally leave a foot long straw of wheat (previous rabi crop) while harvesting by combine or four/five inches straw while harvesting manually. The practice was widely prevalent in the area and the farmers' rationale behind it, as they perceived, was that the summer ploughing helped in control of insect pest by killing of their eggs/larvae by high temperature of the season, as the ploughing exposure them on surface. Farmers had also perceived that summer ploughing enhance the fast decaying of organic matter (previous crop straw) by better mixing it with soil. They also perceived that it enhance aeration of soil, in their words, 'open the mouth of soil,'.

Stale bed preparation was being followed by 168 respondents (n=200). After ploughing the fields, these were flooded and left for a week to facilitate weed growth. Once the weeds attain 2-3 leaves stage, the fields were flooded for 2-3 days or ploughed. The same was being repeated for 2-3 times depending on intensity of weed growth. The respondents perceived that it helped in control of weeds. This had been included as one of the practice in

Table 13: Indigenous practices being followed by farmers

(n=200)

S.No.	Practices	Frequency of respondents
1	Summer ploughing	193
2	Stale bed preparation	168
3	Mixing of neem leaves in paddy seeds during storage	149
4	Spray of kerosine in flooded field	146
5	Dusting turmeric powder	76
6	Burning crop residues	73
7	Spraying washing powder	69
8	Mixing jagarry (gur) in insecticide spray	48

'Package of practices 1999' of GB Pant University Agriculture and Technology Pant Nagar (U.P.).

About 75 per cent farmers (149) of the sample (n=200) were following the practice of mixing neem (*Azadirachta indica*) leaves with paddy seeds during storage. The respondents believed that these leaves had insects repellent properties.

Abraham *et al.* (1975) conducted studies on the efficacy of neem leaves as insects repellent and results of the study confirmed that neem leaves had possessed insects repellent properties.

Spraying of kerosene in flooded field was being followed by 73 per cent of respondents (146) of the sample (n=200). It was done after flooding the fields. Farmers believed that if any caterpillar or adult insect fell into water, got exposed to kerosene oil and kerosene killed them by asphysciation.

The practice of using haldi (turmeric) powder dusting on standing crop in the field is being followed by 39 per cent of the respondents (76, n=200). The farmers perceived that it had insect repellent properties.

The practice of burning crop residues was also being followed by 73 farmers (n=200). Respondents believed that burning of crop residues burn with them insect pest and disease and made the next crop healthy.

A few farmers (69) of the sample (n=200) were spraying washing powder at panicle emergence and grain setting stages for control of rice by infestation, as they believed so.

Few respondents (48) were mixing jagarry (gur) in insecticide spray. The farmers were of the opinion that jagarry improves the adhesiveness of insecticide to plants by this way it enhance the effectiveness of insecticide. They also had the faith that gur particles attract the insect, at insecticide droplet, on the plant leaves and anction of insecticide kills them.

CHAPTER – V

Summary and Conclusion

Rice is the staple food for more than 60 per cent of the world population. Besides as a principle food, it has immense importance in human and animal life. Rice straw is used for cattle feed and many other purposes.

Only wheat exceeds rice in terms of area and production in the world. In India rice occupied an area of 44.59 million ha and produced about 85.99 million tonnes during 1999-2000.

The productivity of rice in the country is lower than many other countries namely South Korea, Australia, Japan, USA and China etc.

In Haryana, during 1999-2000, the total area under rice was 1087 (000ha) with production of 242.4 (000 tonnes) and productivity 2386 kilogram per hectare but according to package practice, potential yield of rice is 6200 kilogram per hectare, even to maintain this productivity level, the use of inputs is being increased year by year. It raises a clash between the economy of the market and economy of nature. The center of such controversies being comparing conventional high input based production

system with sustainable paradigms of agriculture development. Some analysts expressed that the rice cultivation should be given up for more profitable commercial crop and advocated the principle of regional specialization. Other expressed that there should be total diversification of food grain, specially rice cultivation should be given up from rice-wheat system. Another equally strong opinion expressed was that the rice lands should be preserved at all cost, for reasons of food self sufficiency and ecological integrity, as in water logged (rainy season) areas no crop other than rice would succeed. The later group forward the logical suggestion that even of rice-wheat rotation system is to be substituted then substitute wheat, which could be grown in other areas but rice cultivation other than the present flood plains would be impossible. They viewed sustainable agriculture which favoured reduced dependence on inputs and emphasized conservation of farm resources through local technology as a potential alternative to make rice farming more productive and viable in the state.

In this setting of ideational conflict it seemed imperative to know how rice cultivating farmers and extension personnel viewed the concept of sustainability as related to rice production of the state. Therefore, the present study was undertaken in a traditional rice cultivation tract of Haryana, from where unsustainability problems like decreasing productivity (in term of decreasing output per unit of input) and environmental degradation are reported. The specific objectives of the study were:

1. To assess the attitude of farmers and extension workers about concept of sustainability as applied to rice cultivation.
2. To find out the level of knowledge and adoption of recommended practices for sustainable rice production and to identify the constraints in adoption of sustainable practices as perceived by farmers.
3. To identify indigenous practices being followed by farmers to maintain sustainability with respect to rice cultivation.
4. To suggest an extension strategy to promote the adoption of sustainability related practices.

The study was conducted in Karnal and Kaithal districts of Haryana. These districts were selected purposively on the basis of highest area and production of rice in the state.

Further, two blocks from each selected district were selected randomly and from each block one village was again selected randomly. Finally, fifty farmers, from a comprehensive list of rice cultivators from each village, were selected randomly and thus the total sample size was of 200 farmers. Similarly twenty five extension personnel from each selected district were selected randomly and thus making a sample of fifty extension personnel for the study. Farmers were interviewed using a well structured interview schedule which consisted of questions related to their background information, attitude scale, knowledge schedule, adoption schedule,

constraints schedule and they were also asked about the indigenous practices being followed by them. The extension personnel were also interviewed using a well structured interview schedule consisting of questions related to their background information and attitude scale (to measure attitude toward sustainability as applied to rice cultivation). Data were collected through personal interview technique with the help of the above mentioned interview schedule by the researcher himself and analysed.

The salient findings of the study have been summarized as under:

1. The background analysis of respondents revealed that most of the respondents were of young to middle age group with middle level of education, possessed medium sized land holding, belonged to medium level of socio-economic status, possessed low level of family education and social participation, had low level of extension contact with medium level of mass media exposure, risk orientation, economic motivation, change proneness.
2. Farmers and extension personnel differed significantly in their attitude towards the concept of sustainability as applied to rice cultivation. The extension personnel had more favourable attitude towards sustainability (mean is 67.32) than farmers (mean is 53.51).
3. Attitude of farmers towards sustainability showed positive and significant association with land holding, socio-economic status,

education, social participation, family education, economic motivation, mass media exposure and change proneness.

4. The mean knowledge score of the respondents was 47.37 against maximum possible knowledge score of 75 which indicates that farmers possessed a good level of knowledge. Majority of the farmers were distributed in 'medium' and 'high' categories.
5. The knowledge level about variety, fertilizer, weed control and agronomic practices, was high. It was also satisfactory in case of plant protection aspect but was comparatively low in nursery preparation and management.
6. The correlation analysis revealed that land holding, socio-economic status, education, family education, economic motivation, change proneness and attitude towards sustainability found to have significant positive relationship with knowledge level of sustainable rice cultivation technology.
7. The mean adoption score was 25.08 against maximum possible adoption score of 45 which suggests that adoption was of moderate level. There was no wide variation among the farmers with respect to their adoption level, most of the respondents (73%) possessed 'medium' level of adoption and one fourth (25 per cent) of the farmers had high level of adoption.

8. Aspect wise, Adoption level of agronomic practices (71.42%), fertilizer application (60.58%) and weed control (58.66%) was comparatively high. It was of medium level in nursery preparation and management (49.63%), plant protection (46.62%) and variety (46.50%) .
9. Variables like land holding, socio-economic status, education, family education, economic motivation, change proneness, attitude towards sustainability and knowledge level of farmers were having positive significant association with their adoption level of sustainable rice cultivation technology.
10. The study showed that high cost of fertilizer, lack of finance for purchase of inputs, high cost of insecticides fungicides and weedicides, and complicated credit procedure were perceived as very serious constraints by the farmers pertaining to input in the adoption of sustainable practices of rice cultivation.

Similarly high cost of farm labour, lack of remunerative price for the produce and lack of proper knowledge about bio-fertilizers were also perceived as very serious constraints by the farmers, where as lack of knowledge about practices such as application of insecticides and fungicides, biological control of insects/diseases, seed treatment, application of weedicides and non-availability of inputs, high cost of inputs were perceived as serious constraints.

11. Study identified eight indigenous practices related to different production practices in rice cultivation, these are summer ploughing, stale bed preparation, mixing of neem leaves in paddy seeds during storage, spray of kerosene in flooded field, dusting of turmeric powder, burning crop residues, spraying washing powder and mixing jagarry (gur) in insecticide spray, in order of their prevalence in the area.

Conclusion

The overall attitude level of farmers and extension personnel was near about good but farming efficiency and profitability component require more specific attention. The overall knowledge level of farmers about sustainable rice cultivation technology was good however it was comparatively low about nursery preparation and management aspect.

The study further revealed that over all adoption was of moderate level. Adoption level in case of agronomic practices, fertilizer application, and weed control was better but was low in case of plant protection and nursery preparation and management. High cost of inputs, lack of finance, inadequate credit facilities, high cost of labour, lack of remunerative price for the produce and lack of technical knowledge were the major constraints faced by the farmers. Intensive extension efforts, insuring availability of the inputs, simple credit procedure, procurement of the harvested produce at reasonable

price will ultimately lead to sustainable rice cultivation, economical to the farmers and better conservation of natural resources.

Extension Strategy And Action Implications

A. Extension Strategy

The real value of any research lies in the practical utility of its research findings. Hence, an attempt has been made in this chapter to develop an extension strategy for having sustainable rice cultivation in the state. As the present study revealed that a large percentage of recommended rice cultivation practices are not adopted by the farmers, the following measures are being proposed for consideration of extension agencies and other officials engaged in the planning of agricultural development activities of the state:

1. The attitude of extension personal was found favourable only to a moderate extent. The refresher courses for extension personnel should be organized by the authorities. Group discussions should be conducted during such courses to remove their doubts and misgivings which would help in formulating more favourable attitude towards sustainable practices.
2. There is inadequate scientific awareness of various dimensions of technology for sustainable agriculture among farmers. Efforts should be made to educate the farmers through mass media viz. newspapers, farm magazines etc. and short duration training programmes in the villages as per the convenience of the farmers. Study tours to successful farm

sites should also be arranged to increase their knowledge as well as change their attitude.

3. The technologies which are economically viable, socially acceptable and practically feasible need to be popularized and recommended on a massive scale. Demonstrations, group discussions and short duration trainings should be conducted on large scale in the villages so that farmers are motivated to adopt them. These should be followed by field days on the successful demonstration sites.
4. The sustainable rice cultivation would also need diversification as well as changes in crop rotation and cropping patterns. The state govt. should provide proper facilities i.e. availability of farm inputs at reasonable prices as well as marketing facilities for the produce. This will encourage farmers to adopt new crops and enterprises.
5. Non availability of good quality of farm inputs and their high cost were identified as the major in the study. Single window concept and mobile sale points during the season should be arranged at the subsidized rates especially to the small and marginal poor farmers at the village level by the govt., so that the farmers may get genuine quality of inputs at reasonable rates, Moreover, it would save their time and energy considerably in the procurement of the inputs.
6. The majority of the farmers also reported a complicated procedure for obtaining loan from financial institutions. This needs to be simplified.

It is proposed that the govt. should organize face to face interaction of farmers with the bank officials so that they are able to know the problems of the farmers and make necessary changes in the system to facilitate the whole process.

7. The level of extension contact of the farmers was not very satisfactory in the study area. This is a very serious problem. Since it is not feasible for the govt. to increase the number of extension workers, the extension activities of the university and the state department. of agriculture. need to be regularized and closely monitored to have an effective contact with more number of farmers. Simultaneously, some motivating strategy should also be developed in the form of incentives for the extension workers to encourage them to have more and more field visits.
8. The study revealed that adoption level of plant protection measures, improved variety of seed, nursery preparation and its management was comparatively low. Hence, vigorous efforts are needed to educate farmers about these aspects. Campaigns should be organized jointly by the state department of agriculture, CCS Haryana Agricultural University and input agencies to improve knowledge skills and attitude of farmers regarding these aspects of sustainable rice cultivation technology.

9. Farmers are required to sacrifice some short-term benefits to have sustainability. However, due to their poor financial condition most of them are not willing to do so. Hence, the govt. should devise some ways and means to overcome or compensate their losses due to adoption of sustainable farming practices. This can be done by providing alternative schemes of subsidy on inputs related with sustainable practices and more value for their farm produce.

B. Action Implications

The following are the other possible action implications emanated on the basis of present study.

1. The present study has identified indigenous practices in rice cultivation followed by farmers. There is great need of further research by scientists of concerned disciplines, to test the relevancy of these practices. If found relevant then may be incorporated into package of practices.
2. The farming system based research on sustainability issues should be conducted. So that the different package of practices could be developed for different climatic zones at micro level for farmers of different socio-economic status.
3. The study was conducted in four villages of two districts only. Hence, further studies can be conducted covering more village of other

districts with a bigger sample of respondents for better generalization of the results.

4. Govt. should formulate an action plan to encourage the balanced use of fertilizers by restructuring subsidy and educational efforts. In addition, technological recommendations i.e. variety, fertilizer, plant protection measures etc. is made in such a way that net returns of farmers are increased or at least remain the same while adopting sustainable practices.
5. A further study should be conducted to know the motives of farmers for using indigeneous practices rather than scientific technology i.e. farmers opinion about or reasons of using indegenous practices.

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Appendix - I

**Department of Extension Education
College of Agriculture
CCS Haryana Agricultural University, Hisar - 125 004**

Interview Schedule For Farmers

Title of the research project : Sustainability of Rice
Cultivation in Haryana

Sr. No. _____

Name of Respondent : _____

Name of Village : _____

Part-I

1. Age _____ years.

Land holding _____ acre. Area under rice cultivation _____ acre.

Irrigated area _____ acre

Area irrigated by canal only _____ acre

Area irrigated by tubewell only _____ acre

Area irrigated by both _____ acre

1. Socio-economic status**(a) Education**

- | | | | |
|-------------------------|-----|------------------------|-----|
| i) illiterate | (0) | iv) middle | (4) |
| ii) can read only | (1) | vi) high school | (5) |
| iii) can read and write | (2) | vi) graduate and above | (6) |
| iv) primary | (3) | | |

(b) Caste

- | | | | |
|--------------------|-----|------------------------|-----|
| i) Schedule caste | (1) | iv) Agricultural caste | (4) |
| ii) Lower caste | (2) | v) Prestige caste | (5) |
| iii) Artison caste | (3) | vi) Dominant caste | (6) |

(c) Occupation

- | | | | |
|----------------------|-----|----------------------------|-----|
| i) Labour | (1) | iv) Independent profession | (4) |
| ii) Caste occupation | (2) | v) Cultivation | (5) |
| iii) Business | (3) | vi) Service | (6) |

(d) House

- | | | | |
|-------------|-----|-------------|-----|
| i) No house | (0) | iv) Mixed | (3) |
| ii) Hut | (1) | v) Pucca | (4) |
| iii) Kachha | (2) | vi) Mansion | (6) |

(e) Land holding

- | | | | |
|------------------------|-----|-------------------------|-----|
| i) No land | (0) | v) 11-15 acreas | (4) |
| ii) Less than one acre | (1) | vi) 16-20 acres | (5) |
| iii) 1-5 acres | (2) | vii) More than 20 acres | (6) |
| iv) 6-10 arces | (3) | | |

(f) Family :**Type**

- | | |
|------------|-----|
| i) Nuclear | (1) |
| ii) Joint | (2) |

Size

- | | |
|---------------------------|-----|
| i) Up to five members | (1) |
| ii) Above five | (2) |
| iii) Distinctive features | (2) |

(g) Material possession :

- | | | | |
|-----------------|-----|---------------------|-----|
| i) Bullock cart | (1) | v) Television | (2) |
| ii) Cycle | (1) | vi) Motor cycle | (2) |
| iii) Radio | (1) | vii) Improve Agril. | (2) |
| iv) Chairs | (1) | implement | |

(h) Farm power

- | | |
|---|--------------------------|
| i) No. of draft animal (0) | v) 5-6 draft animals (6) |
| ii) 1-2 draft animals (2) | vi) Power tiller (6) |
| iii) 3-4 draft animals (4) | vii) Tractor (6) |
| iv) One or more (4)
prestige animals | |

(i) Social participation

- | | |
|---|-----|
| i) Member of no organisation | (0) |
| ii) Member of one organisation | (1) |
| iii) Member of more than one organisation | (2) |
| iv) Office holder | (3) |

2. Family education

Family members	Age	Educational level
1.		
2.		
3.		
4.		
5.		
6.		

Whereas illiterate (0); can read only (1); can read and write (2); Primary (3); Middle (4); Matric (5); Graduate and above (6)

3. Risk orientation :

	SA	A	UD	DA	SDA
(a) A farmer should grow large number of crops to avoid greater risk involved in growing one or two crops					
(b) A farmer should rather take more a chance in making a big profit than to be content with a smaller but less risky profit.					

	SA	A	UD	DA	SDA
(c) A farmer who is willing to take greater risk than the average farmers usually does better financially					
(d) It is good for a farmer to take risk when he knows his chance of success is fairly high					
(e) It is better for a farmer not to try new farming methods unless most others in the locality have used it with success					
(f) Trying entirely new methods in farming by a farmer involved risk but it is worth of it					

Note: Responses were quantified in the following manner:

	For positive statements	For negative statements
SA - Strongly agree	7	1
A - Agree	5	3
UD - Undecided	4	4
DA - Disagree	3	5
SDA - Strongly disagree	1	7

4. Economic motivation	Most like	Least like
I. (a) All I want from my farm is to make just a reasonable living for the family		
(b) In addition to making reasonable amount of profit the enjoyment in farming life is also important for me		

	Most like	Least like
(c) I would invest in farming to the maximum to gain large profits		
II.(a) I do not hesitate to borrow any amount of money in order to run the farm properly		
(b) Instead of growing new cash crops which cost more money I grow food crops.		
(c) It is not only monetary profit but the enjoyment of work well done which gives me satisfaction for my hard work on the farming		
III.(a) I have not to borrow money, on principle, even when it is necessary for running the farm		
(b) My main aim is maximizing profit by growing cash crops in comparison to growing of crops which are simply consumed by my family		
(c) I avoid excessive borrowing of money for farm investment		

Note: Responses were quantified in the following manner:

	For favourable statements	For unfavourable statements
Most like	2	1
Least like	1	2

5. Change proneness

	Most like	Least like
I(a) I try to keep myself, update with information in improved farm practices but that does not mean that I try out all the new methods at my farm.		
(b) I feel restless till I try out an improved farm practice I have heard about		
(c) They talk of many improved farm practices these days but who knows if they are better than the old ones		
II (a) From time to time I have heard of several improved farm practices and I have tried out most of them in last few years		
(b) I usually wait to see what results my neighbours obtain before I try out the improved farm practices		
(c) Sometimes I believe that the traditional ways of farming are best		
III(a) I am cautious about trying an improved practices		
b) After all our forefathers were wise on their farming practices and I do not see any reason for changing these old methods		
c) Often new improved farm practices are not successful, however, if they are promising I would surely like to adopt them.		

Note: Responses were quantified in the following manner:

	For favourable statements	For unfavourable statements
Most like	2	1
Least like	1	2

6. Mass media exposure

1. Do you have a radio/transistor? Yes/No (1 - 0)
2. Do you listen Krishi Jagat Programme? Yes/No
if yes, then how frequently, Daily/Often/Sometimes
(3) (2) (1)
3. Do you subscribe any form magazine. Yes/No
if yes, mention the name of magazines. _____ (1)
4. Do you have TV? Yes/No
5. Do you see Krishi Darshan Programme Yes/No
on TV?
if yes, then how frequently, Daily/Often/Sometimes
(3) (2) (1)
6. Have you visited any farmer's fair Yes/No
for agricultural exhibition
if yes,

S.No.	When	Where
1.		
2.		
3.		
4.		

(One score for each visit)

7. Do you read daily newspaper. Yes/No
Where : Yours home/At Neighbourhood/Panchayat Bhawan or shop
(3) (2) (1)

How frequently : Daily/Often/When any important news/When get time
(4) (3) (2) (1)

7. Extension contact :

1. Do you know following extension personnels and if know then the degree of contact :

S. No.	Officer	Know		If yes name (1)	Office (1)	More than 2-3 times a week (4)	2-3 times in a fortnight (3)	2-3 times in a month (2)	Seldom (1)
		Yes (1)	No						
1.	ADO								
2.	BDO								
3.	CAO								
4.	SDAO/ SMS								
5.	DDA								

2. Have you or any member of your family acquired training in last three years.
If yes Yes/No

S.No.	When	Duration	Subject	Where

(One score for each training)

- 3.(a) Do you know where KVK is situated Yes/No
(1)

- (b) Name the scientist, you contacted there.

Name of the scientist

- 1.
- 2.
- 3.

- 4.(a) How many times you visited KVK last year.

S.No.	When	Why work	Whether work completed

(Two score for each name)

PART - II
Attitude Scale

Statements	Response				
	SA	A	UD	DA	SDA
A. Cultivation of rice in traditional way is better even though it fetches less profit as it does not bring harm to ecology.					
B. Continued intensification of agricultural production practices will destroy the long term productive capacity of the agro ecosystem.					
C. High level of input use has to be continued for profitable rice production.					
D. Modern cultivation practices are responsible for the high pesticide residue in water and grain causing serious health problems.					
E. It is better to follow rice-wheat cropping to make profit rather than going for diversification.					
F. It is wiser to use organic manures rather than chemical ones.					
G. Integration of traditional and improved practices can well sustain the rice production system in the long run.					
H. Indiscriminate use of chemical inputs need control through legal sanctions.					

Statements	Response				
	SA	A	UD	DA	SDA
I. Even at the cost of reducing one's profit, one must take care of ecological factors like soil, air and water.					
J. Construction of bunds has been beneficial for the rice production					
K. It is better to cultivate paddy using modern scientific ways as it is more profitable, does not matter the ecological damage.					
L. Intensification of agriculture production practices should be continued to ensure maximum annual profit.					
M. High level of fertilizer and plant protection chemical use has made the ecosystem endemic to many pests and epidemics.					
N. Farming practices in rice should aim at improving the production rather than ensuring health and well being of local populace.					
O. Crop diversification will be a better option for making rice cultivation economical rather than following single crop rotation pattern.					

Statements	Response				
	SA	A	UD	DA	SDA
P. Use of chemical inputs is the most viable option for maintaining the high productivity of rice in the area.					
Q. More indigenous inputs will make rice cultivation totally unfeasible in the area.					
R. Crop diversification is too tedious than cost worthy with regard to our rice cultivation.					

Note: Responses were quantified in the following manner :

Response	For positive statements	For negative statements
SA - Strongly agree	5	1
A - Agree	4	2
UD - Undecided	3	3
DA - Disagree	2	4
SDA - Strongly disagree	1	5

PART-III
Knowledge of Farmers

1. Mention varieties of kharif paddy recommended in your area.
 - i) Short duration (any two) _____
 - ii) Medium duration (any two) _____
 - iii) Basmati (any two) _____
 2. What is the optimum sowing time in the nursery bed?
 3. What is the recommended seed rate per acre?

 4. Should the seed be treated before sowing? Yes/No
If yes,
 - i) Name the chemical
 - ii) Dose
 5.
 - i) What should be the area of the nursery bed for transplanting one acre of land?
 - ii) Should the nursery bed be :
 - a) Flat or
 - b) Raised?If raised, what should be the size?
 - iii) Whether fertilizers should be applied to the nursery bed before sowing? Yes/No
If yes, specify the quantity of fertilizers required for a nursery area of 0.1 acre.

Name of fertilizer(s)	Quantity
 - iv) Whether the seedlings should be treated before transplanting? Yes/No
If yes, mention the following,

Name of chemical	Dose	Stage of application
(a) Insecticide		
(b) Fungicide		
6. Transplanting
 - (a) At what age the seedlings should be transplanted?
 - i) Short duration _____

- ii) Medium duration _____
 iii) Basmati _____

(b) How many seedlings should be planted per hill?

(c) Should the seedlings be transplanted in line? Yes/No

If yes, what should be the optimum spacing?

- i) Timely sown dwarf rice _____
 ii) Timely sown basmati rice _____
 iii) Late sown (both) _____

7. Fertilizer application

Whether manures and fertilizers should be applied Yes/No
 to the main field?

If yes, state the following (for any improved variety)

Var.	Name of fertilizer(s)	Quantity	Mode of application

8. Water management

What level of water should be maintained in the paddy field?

9. Name the two scientific methods of weed control?

- i) _____ ii) _____

10. Plant protection measures

(a) Name two serious insect pests of paddy prevalent in your area and specify their control measures.

S.No.	Name of insect pest	Recommended chemical	Dose/acre
1.			
2.			

(b) Name one serious disease of paddy prevalent in your area and specify its control measures.

Name of disease	Recommended chemical	Dose/acre

PART-IV
ADOPTION

1. Adoption of improved varieties

i) Total area under rice acre (s)

ii) Name of variety(s) grown	Area under variety (acres)	Percentage of improved variety to total area under rice

2. What seed rate did you use per acre for nursery :

(Any one variety)

(a) Dwarf _____

(b) Basmati _____

3. Seed treatment

(i) Did you treat the seed before sowing? Yes/No

(ii) If yes mention the following?

a) Name of chemical used _____

b) Dose used/kg of seed _____

4. Nursery bed preparation, sowing and nursery management.

Please state 'Yes' or 'No' against the following statements.

a) Prepared raised nursery bed as per recommendation Yes/No

b) Area of the nursery bed was one-tenth of the main field Yes/No

c) Sowing of seed was done within : 15th may to 30 June (or Up to ± 7 days) for short duration Yes/No

Sowing of seed was done within : 15th may to 30 May (or Up to ± 7 days) for medium duration Yes/No

Sowing of seed was done within : 1st June to 30 June (or Up to ± 7 days) for basmati Yes/No

d) Applied fertilizer to the nursery bed before sowing. If yes, mention the doze Yes/No

e) Applied insecticide to the seedlings at recommended stage. If yes, what was the doze Yes/No

f) Applied fungicide to the seedlings at recommended state. If yes, mention the doze Yes/No

5. Transplanting

(i) At what age did you transplant the seedlings? (Anyone)

- a) Short duration :
- b) Medium duration :
- c) Basmati :

(ii) Did you adopt line transplantation? Yes/No

If yes, what spacing was followed? (Anyone type)

- a) Timely sown dwarf _____
- b) Basmati _____
- c) Late sown (both) _____

(iii) How many seedlings did you plant per hill?

6. Water management

What level of water was maintained in your rice field? _____

7. Fertilizer application

i) Did you make use of chemical fertilizers in rice cultivation? Yes/No

If yes, mention the following :
(for anyone variety)

Variety	Fertilizer(s) applied	Dose/acre	Mode of application (Basal/top dressing)

ii) Did you make use of bio-fertilizers?

Variety	Name of fertilizer applied	Dose/acre	Mode of application (Basal/top dressing)

8. Weed control

Did you control weeds of your rice field?

Yes/No

If yes, what method did you follow?

- a) Hand weeding
- b) Mechanical weeding
- c) Chemical weed control
- d) Stale bed preparation

9. Plant protection measures

- (i) What was the most serious insect pest in your paddy field and what chemical did you use as control measure?

Name of insect pest	Chemical used	Dose/acre used

- (ii) Did you follow biological control of insect-pest?
If yes, please mention.

Name of insect-pest	Biological control used	Dose/acre used

- (iii) What was the most serious disease in your rice field and what control measure did you adopt?

Name of disease	Chemical used	Dose per acre used

PART-V
CONSTRAINTS IN THE ADOPTION

	VS	S	NSS
A. Inputs			
1. High cost of fertilizer			
2. Lack of finance for purchase of inputs			
3. High cost of insecticides, fungicides and weedicides			
4. Non-availability of weedicide, pesticide at required time			
5. Non-availability of biological material for pest control.			
6. High cost of good quality seed			
7. Non-availability of quality seed			
8. Inadequate credit facilities for purchase of inputs			
9. Complicated credit procedure			
10. Non-availability of chemical fertilizer in time			
11. Non-availability of biofertilizer			
12. Lack of guidance for availing credit facilities			
B. Production process			
1. High cost of labour			
2. Non-availability of skilled labour in time			
3. Difficulty in draining away excessive water from the field, for want of drainage system			
4. Lack of irrigation facilities			
C. Marketing			
1. Lack of remunerative price			
2. Distress sale due to immediate need of money			
3. Inadequate procurement through Govt./Semi-Govt. agencies			
D. Technical knowledge			
1. Lack of proper knowledge for application of insecticides and fungicides			
2. Lack of knowledge about biological control of insect/disease.			
3. Lack of technical knowledge for seed treatment			
4. Lack of proper knowledge for application of weedicides			
5. Lack of proper technical knowledge for seedling treatment			
6. lack of proper knowledge for application of fertilizers in the nursery bed and mainfield			
7. Lack of knowledge about biofertilizers			
8. Lack of knowledge of high yielding varieties.			

VS = Very serious; S = Serious; NSS = Not so serious

Note: Responses were quantified according to degree of perceived seriousness of a particular constraint by the respondents.

For constraints perceived as very serious	For constraints perceived as serious	For constraints perceived as not so serious
3	2	1

APPENDIX - II
Interview Schedule for Extension Personnels

1. Name : _____
2. Designation : _____
3. Educational Qualification : _____
4. No. of years in Service : _____
5. No. of years experience of : _____
 Technology dissemination in
 rice cultivation area

Attitude scale

Listed below are several views regarding rice cultivation. For each statement please indicate your degree of agreement or disagreement by giving mark against the appropriate column.

SA-strongly agree, A-Agree, UD-undecided, DA-disagree, SDA-Strongly disagree

Statements	Response				
	SA	A	UD	DA	SDA
A. Cultivation of rice in traditional way is better even though it fetches less profit as it does not bring harm to ecology.					
B. Continued intensification of agricultural production practices will destroy the long term productive capacity of the agro ecosystem.					
C. High level of input use has to be continued for profitable rice production.					
D. Modern cultivation practices are responsible for the high pesticide residue in water and grain causing serious health problems.					

Statements	Response				
	SA	A	UD	DA	SDA
E. It is better to follow rice-wheat cropping to make profit rather than going for diversification.					
F. It is wiser to use organic manures rather than chemical ones.					
G. Integration of traditional and improved practices can well sustain the rice production system in the long run.					
H. Indiscriminate use of chemical inputs need control through legal sanctions.					
I. Even at the cost of reducing one's profit, one must take care of ecological factors like soil, air and water.					
J. Construction of bunds has been beneficial for the rice production					
K. It is better to cultivate paddy using modern scientific ways as it is more profitable, does not matter the ecological damage.					
L. Intensification of agriculture production practices should be continued to ensure maximum annual profit.					
M. High level of fertilizer and plant protection chemical use has made the ecosystem endemic to many pests and epidemics.					

Statements	Response				
	SA	A	UD	DA	SDA
N. Farming practices in rice should aim at improving the production rather than ensuring health and well being of local populace.					
O. Crop diversification will be a better option for making rice cultivation economical rather than following single crop rotation pattern.					
P. Use of chemical inputs is the most viable option for maintaining the high productivity of rice in the area.					
Q. More indigenous inputs will make rice cultivation totally unfeasible in the area.					
R. Crop diversification is too tedious than cost worthy with regard to our rice cultivation.					

Note: Responses were quantified in the following manner :

Response	For positive statements	For negative statements
SA - Strongly agree	5	1
A - Agree	4	2
UD - Undecided	3	3
DA - Disagree	2	4
SDA - Strongly disagree	1	5

APPENDIX – III

Scoring Procedure to Ascertain the knowledge level of Each selected component of Paddy Production technology

	C	PC	W
1. Name of improved variety			
(i) Short duration (each variety)	2	-	0
(ii) Medium duration (each variety)	2	-	0
(iii) Basmati (each variety)	2	-	0
2. Optimum sowing time	1	-	0
3. Seed rate			
(i) Short duration	2	1	0
(ii) Medium duration	2	1	0
(iii) Basmati	2	1	0
4. Seed treatment			
(i) Name of recommended chemical	1	-	0
(ii) Dose	2	1	0
5. Nursery preparation and management			
(i) Optimum nursery area	1	-	0
(ii) Nursery type	1	-	0
(iii) Fertilizer application to the nursery bed before sowing			
a) Quality of N-fertilizer	2	1	0
b) Quantity of P-fertilizer	2	1	0
c) Quantity of K-fertilizer	2	1	0
d) Quantity of Biofertilizer/organic manure	2	1	0
(iv) Seedling treatment			
A. Insecticide application			
a) Name of recommended chemical	1	-	0
b) Dose of chemical	2	1	0
c) Proper stage of application	1	-	0
B. Fungicide application			
a) Name of recommended fungicide	1	-	0
b) Dose	2	1	0
c) Proper stage of application	1	-	0
6. Transplanting			
a) Age of seedling			
i) Short duration	2	1	0

	ii) Medium duration	2	1	0
	iii) Basmati	2	1	0
b)	Number of seedlings per hill	2	1	0
c)	Spacing			
	i) Timely sown (dwarf)	2	1	0
	ii) Timely sown (Basmati)	2	1	0
	iii) Late sown (dwarf)	2	1	0
	iv) Late sown (basmati)	2	1	0
7.	Fertilizer application			
a)	Quantity			
	i) N-fertilizer	2	1	0
	ii) P-fertilizer	2	1	0
	iii) K-fertilizer	2	1	0
	iv) Bio-fertilizer/organic manure	2	1	0
b)	Mode of application			
	i) N-fertilizer	1	-	0
	ii) P-fertilizer	1	-	0
	iii) K-fertilizer	1	-	0
	iv) Bio-fertilizer/organic manure	1	-	0
8.	Water management			
	Level of water in the field	1	-	0
9.	Weed Control			
	Scientific method of weed control (each)	2	-	0
10.	Plant protection measures			
a)	Insect control			
	i) Name of insect pest	2	-	0
	ii) Recommended chemical	1	-	0
	iii) Dose per acre	2	1	0
b)	Disease control			
	i) Name of disease	2	-	0
	ii) Recommended chemical	1	-	0
	iii) Dose per acre	2	1	0

C = Correct knowledge; PC = Partial correct knowledge;

W = Wrong answer or no knowledge

APPENDIX – IV

Scoring Procedure to Ascertain the Adoption Level of Each Selected Component of PPT

1. Improved variety
 - i) 76-100% area under improved varieties 4
 - ii) 51-75% area under improved varieties 3
 - iii) 26-50% area under improved varieties 2
 - iv) Upto 25% area under improved varieties 1
 - v) Improved variety not sown 0
2. Seed rate
 - i) 15-18 kg (fine grain variety)/18-21 kg (medium grain variety)/21-24 kg (coarse grain variety) 2
 - ii) Upto $\pm 20\%$ of the recommendation 1
 - iii) Other than this 0
3. Seed treatment
 - i) a) Recommended chemical used 1
 - b) Other than this 0
 - ii) a) Correct dose of chemical used 2
 - b) Upto $\pm 20\%$ of recommended dose 1
 - c) Other than this 0
4. A. Nursery bed preparation
 - i) a) Prepared raised nursery bed 1
 - b) Other than this 0
 - ii) a) Nursery area as per recommendation 1
 - b) Other than this 0

B. Sowing time

 - a) 15th June-15th July (and upto ± 7 days) 1
 - b) Other than this 0

C. Nursery management

 - i) a) Applied fertilizer to the nursery bed at proper time 1

	b)	Other than this	0
ii)	a)	Applied insecticide to the seedling & proper stage	1
	b)	Other than this	0
iii)	a)	Applied fungicide to the seedlings at proper stage	1
	b)	Other than this	0
4.	Transplanting		
	A. Age of seedling		
	i)	Age of seedlings was 3 weeks (early variety)/4 weeks (mid variety)/5 weeks (late variety)	2
	ii)	Upto ± 5 days	1
	iii)	Other than this	0
	B. Line transplantation		
	i)	Followed spacing of 8 x 6" for early and mid variety/9 x 9" for late varieties	2
	ii)	1 inch variation in both line to line and plant to plant spacing	1
	iii)	Other than this	0
	C. Number of seedlings		
	i)	Planted 2-3 number of seedlings per hill	2
	ii)	Planted 3-4 number of seedlings per hill	1
	iii)	Other than this	0
6.	Water management		
	i)	1-2" of water level maintained in the field	2
	ii)	2-4" of water level maintained in the field	1
	iii)	Other than this	0
7.	Fertilizer application		
	A. Nitrogenous fertilizer		
	i)	a) Recommended dose and upto $\pm 10\%$ variation	2

	b)	From $\pm 10\%$ to $\pm 25\%$ of recommended dose	1
	c)	Other than this	0
ii)	a)	Fertilizer applied as per recommended Split dose	1
	b)	Other than this	0
B. Phosphatic fertilizer			
i)	a)	Recommended dose and upto $\pm 10\%$ variation	2
	b)	From $\pm 10\%$ to $\pm 25\%$ of recommended dose	1
	c)	Other than this	0
ii)	a)	Fertilizer applied at proper stage	1
	b)	Other than this	0
C. Potassic fertilizer			
i)	a)	Recommended dose and upto $\pm 10\%$ Variation	2
	b)	From $\pm 10\%$ to $\pm 25\%$ of recommended dose	1
	c)	Other than this	0
ii)	a)	Fertilizer applied at correct stage	1
	b)	Other than this	0
D. Bio-fertilizer			
i)	a)	Recommended dose and upto $\pm 10\%$ variation	2
	b)	From $\pm 10\%$ to $\pm 25\%$ of recommended dose	1
	c)	Other than this	0
ii)	a)	Fertilizer applied at correct stage	1
	b)	Other than this	0

8. Weed control
 - i) Followed hand weeding 1
 - ii) Followed mechanical weeding 2
 - iii) Followed chemical weed control method 2
 - iv) Stale bed preparation 2
9. Plant protection measures
 - A. Insect control
 - i)
 - a) Could identify the proper insect 1
 - b) Other than this 0
 - ii)
 - a) Recommended chemical/biological control used 1
 - b) Other than this 0
 - iii)
 - a) Correct dose used 2
 - b) Upto $\pm 20\%$ of recommended dose used 1
 - c) Other than this 0
 - B. Disease control
 - i)
 - a) Could identify the proper disease 1
 - b) Other than this 0
 - ii)
 - a) Recommended chemical used 1
 - b) Other than this 0
 - iii)
 - a) Correct dose of chemical used 2
 - b) Upto $\pm 20\%$ of recommended dose used 1
 - c) Other than this 0

ABSTRACT

Title of Thesis	: SUSTAINABILITY OF RICE CULTIVATION IN HARYANA
Name of Degree Holder	: DHARMENDRA KUMAR SHIVRAIN
Title of Degree	: Doctor of Philosophy in Extension Education
Name & Address of Major-advisor	: Dr. V.K. Makhija , Professor Department of Extension Education, CCS Haryana Agricultural University Hisar-125004 (India)
Degree awarding University	: CCS Haryana Agricultural University, Hisar-125004. (India)
Year of Award of Degree	: 2002
Major Subject	: Extension Education
Total no. of pages in thesis	: 109 + xxix
Total no. of words in Abstract	: 525 Approximately

(An abstract of thesis presented in partial fulfillment of the requirements for the degree of Ph.D., of Chaudhary Charan Singh Haryana Agricultural University, Hisar).

The present study was undertaken with four objectives: viz (1) To assess the attitude of farmers and extension workers about concept of sustainability as applied to rice cultivation (2) To find out the level of knowledge and adoption of recommended practices for sustainable rice production and to identify the constraints in adoption of sustainable practices as perceived by farmers (3) To identify indigenous practices being followed by farmers to maintain sustainability with respect to rice cultivation (4) To suggest an extension strategy to promote the adoption of sustainability related practices.

The study was conducted in Karnal and Kaithal districts which were selected purposively because of having highest production as well as area under rice in Haryana. Two blocks were selected from each district randomly and one village from each block was selected randomly. Fifty farmers were selected randomly from each village, making a sample of 200 respondents.

The study indicated that majority of the respondents were of middle age group, had middle level of education, land holding, socio-economic status, mass media exposure, risk orientation, economic motivation and change proneness, where as majority of them having low level of extension contact and social participation.

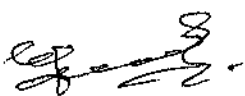
Farmers and extension personnel differed significantly in their attitude towards the concept of sustainability as applied to rice cultivation. The extension workers had more favourable attitude towards sustainability (mean is 67.32) than farmers (mean is 53.51). Attitude of farmers towards sustainability showed positive and significant association with land holding, socio-economic status, education, social participation, family education, economic motivation, mass media exposure and change proneness.

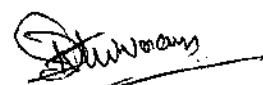
The mean knowledge of the respondents was 47.37 against maximum possible score of 75 which indicates that farmers possessed a good level of knowledge. The knowledge level about variety, fertilizer, weed control and agronomic practices was high. It was also satisfactory in case of plant protection aspect but was comparatively low in nursery preparation and management. The correlation analysis revealed that land holdings, socio-economic status education, family education, economic motivation, change proneness and attitude towards sustainability found to have significant positive relationship with knowledge.

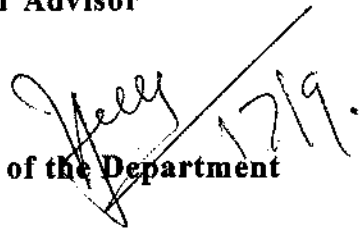
The mean adoption score was 25.08 against maximum possible adoption score of 45 which suggests that adoption was of moderate level. Adoption level of agronomic practices (71.42%) fertilizer application (60.58%) and weed control (58.66%) was comparatively high. It was of medium level in nursery preparation and management (49.63%), plant protection (46.62%) and variety (46.50%). Variables like land holding, socio-economic status, education, family education, economic motivation, change proneness, attitude towards sustainability and knowledge level of farmers were having positive significant association with their adoption level of sustainable rice cultivation technology.

The major constraints perceived by farmers in the adoption were, high cost of fertilizer, lack of finance for purchase of inputs, high cost of insecticides, fungicides and weedicides, complicated credit procedure, high cost of farm labour, lack of remunerative price for the produce and lack of proper knowledge about bio-fertilizers.

Study identified eight indigenous practices related to different production practices in rice cultivation, namely summer ploughing, stale bed preparation, mixing of neem leaves in paddy seeds during storage, spray of kerosene in flooded field, dusting of turmeric powder, burning crop residues, spraying washing powder and mixing jagarry in insecticide spray.


Major Advisor


Signature of the Candidate


Head of the Department

