

FACTORS AFFECTING SUSTAINABILITY OF AGRICULTURE IN SMALL FARM PRODUCTION SYSTEM IN COASTAL ECOSYSTEM OF ORISSA

By

BISHNU PRIYA MISHRA



**DEPARTMENT OF EXTENSION EDUCATION, COLLEGE OF AGRICULTURE
ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY,
BHUBANESWAR – 751 003**

2006

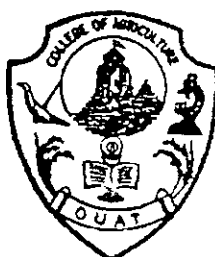
**FACTORS AFFECTING SUSTAINABILITY OF
AGRICULTURE IN SMALL FARM PRODUCTION
SYSTEM IN COASTAL ECOSYSTEM OF ORISSA**

**A
THESIS SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESWAR
FOR FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF**

**DOCTOR IN PHILOSOPHY
(EXTENSION EDUCATION)**

By

BISHNU PRIYA MISHRA



**DEPARTMENT OF EXTENSION EDUCATION, COLLEGE OF AGRICULTURE
ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY,
BHUBANESWAR – 751 003**

2006

DEDICATED

TO

MY BELOVED

GRAND MOTHER

Dr. C. Satapathy, Ph.D. (IARI)
Director, Amity Institute of Rural Management,
AMITY UNIVERSITY.

C E R T I F I C A T E

This is to certify that the thesis entitled "Factors affecting Sustainability of Agriculture in small farm production system in coastal ecosystem of Orissa" submitted for fulfillment of the requirements for the award of Doctor in Philosophy in Extension Education of the Orissa University of Agriculture and Technology, Bhubaneswar – 751003, is a record of bonafide research work carried out by Smt Bishnu Priya Mishra under my guidance and supervision. No part of the thesis has been submitted for any other degree or diploma or published in any other form. Such help or source of information, as has been availed of during the course of investigation has been duly acknowledged by her.

Bhubaneswar,
Dated 1st Feb. 06


(C. Satapathy)
Advisor

FACTORS AFFECTING SUSTAINABILITY OF AGRICULTURE IN SMALLFARM PRODUCTION SYSTEM IN COASTAL ECOSYSTEM OF ORISSA

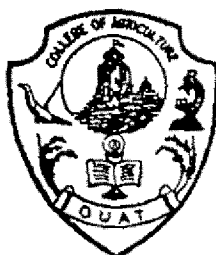
A
THESIS SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESWAR
FOR FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR IN PHILOSOPHY
(EXTENSION EDUCATION)

2006

By

BISHNUPRIYA MISHRA



APPROVED BY :

1. ADVISOR

: *[Signature]* 15/7/06

2. HEAD OF DEPARTMENT
OF EXTENSION EDUCATION

: *[Signature]* 15.7.06

3. EXTERNAL EXAMINER

: *[Signature]* 15/7/06

ACKNOWLEDGEMENT

I deem it a unique opportunity and proud privilege to record my deep sense of gratitude and indebtedness to my guide Dr. Chakradhar Satapathy, Former Dean, Extension Education, O.U.A.T. and Present Director, Amity Institute of Rural Management for suggesting the problem and providing all valuable guidelines for conducting the research work. I am extremely thankful and much obliged for his cheerful disposition and all the help extended to me without any resentment.

I owe a deep sense of gratefulness to Prof. D.P.Ray, Dean, Extension Education, O.U.A.T., Dr. P.K.Mohapatra, Dean, College of Agriculture, O.U.A.T., Dr. B.C.Nayak and Dr. D.Sahoo, Former Deans, College of Agriculture, O.U.A.T. for their necessary guidance and help throughout the study.

I am deeply indebted to Dr. R.K.Raj, Head, Department of Extension Education for his inspiration and constant encouragement during my research work.

It is my great pleasure to thank Sri Niranjan Nayak, Training Organiser, K.V.K., Bhanjanagar, Dr. R.N.Dash, Dr. S.K.Rout, Mr. B.P.Mohapatra and Mr. B.K. Mohapatra for their constant encouragement and cooperation during the entire period of work.

I am thankful to all my friends, relatives and well wishers for their support and encouragement. I thank to all the office staff of Dean, College of Agriculture, Department of Extension Education, Directorate of Extension and K.V.K., Bhanjanagar for their help and cooperation rendered during the study.

My special thank is due to my daughter 'Aditi' without whose cooperation the work could not have been completed. I bow down before my Grand mother, parents, in-laws and elders whose love, interest, inspiration and constant encouragement kept me in good spirit throughout my studies.

Dated: 1. 2. 2006

Bishnu Priya Mishra
(Smt. Bishnu Priya Mishra)

C O N T E N T S

CHAPTER NO.	PARTICULARS	PAGE NO.
I	INTRODUCTION	1 to 9
II	REVIEW OF LITERATURE	10 to 36
III	ORISSA AT A GLANCE	37 to 54
IV	RESEARCH METHODOLOGY	55 to 77
V	FINDINGS AND DISCUSSION	78 to 149
VI	SUMMARY AND CONCLUSION	150 to 162
	BIBLIOGRAPHY	163 to 179
	APPENDIX I	i to xiv
	APPENDIX II	xv to xviii

LIST OF TABLES

Table No.	Title of the Table	Page No.
1	Orissa at a glance (2001 census)	37
2	Month wise climatic condition of Orissa(average of last fifty years)	43
3	Irrigated potentialities of the state (2000-2001)	44
4	Area under irrigation in different districts	45
5	Cropping intensity of various districts in Orissa	46
6	Land utilization pattern in Orissa	48
7	Net irrigation potential in the state through different types of sources	49
8	Position of Orissa in Consumption of fertilizer at all India level	50
9	Status of operational holdings in the state	51
10	Livestock population in Orissa	52
11	Year wise production and per capita availability of milk, meat and eggs in Orissa	53
12	Total Production of fish in Orissa	53
13	District wise distribution of coastal saline lands in Orissa with present land use	55
14	Analysis of water logging in the coastal districts	56
15	Villages, Blocks and Districts under study	58
16	Basic facts about the villages under investigation (2004-05)	59
17	Profile of sample under study	79
18	Independent variables of sample profile	80
19	Classification of sample based on level of perception(n=200)	81

Table No.	Title of the Table	Page No.
20	Age and perception on sustainability about agriculture	82
21	Education and perception on sustainability of agriculture	83
22	Composition of family and perception of sustainability in agriculture	84
23	Family type and perception of sustainability in agriculture	84
24	Caste and perception of sustainability in agriculture	85
25	Membership in formal organization and perception of sustainability in agriculture	86
26	Land holding and perception of sustainability in agriculture	87
27	Occupation and perception of sustainability in agriculture	88
28	Crops grown and perception of sustainability in agriculture	89
29	Animal wealth and perception of sustainability in agriculture	89
30	Additional source of income and perception of sustainability in agriculture	90
31	Use of energy and perception of sustainability in agriculture	91
32	Possession of farm machinery in agriculture	92
33	Exposure to mass media and perception of sustainability in agriculture	92
34	Marketable farm produce and perception of sustainability in agriculture	93
35	Opinion about sale price and perception of sustainability in agriculture	94

Table No.	Title of the Table	Page No.
36	Place of marketing and perception of sustainability in agriculture	95
37	Training undergone and perception of sustainability in agriculture	96
38	Variation in the profile of sample of districts under study	96
39	Ranking of factors in sustainability in agriculture	103
40	Ecological soundness and reaction of the sample	105
41	Economic viability and reaction of the sample	107
42	Social accessibility and reaction of the sample	109
43	Humaneness and reaction of the sample	110
44	Adaptability and reaction of the sample	111
45	Gap in percentage about the sustainability in agriculture	112
46	Factors and perception of sustainability in agriculture	113
47	Percentage contribution of factors of sustainability towards sustainable agriculture	113
48	Villages under study	117
49	Relative position of villages in SAI in terms of ecological soundness	118
50	Relative position of villages in SAI in terms of economic viability	119
51	Relative position of villages in SAI in terms of social accessibility	120
52	Relative position of villages in SAI in terms of humaneness	121
53	Relative position of villages in SAI in terms of adaptability	122
54	Overall sustainable agriculture index (SAI) of the sample area	122
55	ANOVA Table	123

Table No.	Title of the Table	Page No.
56	Sub-components of Ecological soundness	124
57	Sub-components of Economic Viability	125
58	Sub-components of Social accessibility	126
59	Sub-components of Humaneness	127
60	Sub-components of Adaptability	127
61	Correlation matrix of the variables of Sustainability of Agriculture	130
62	Adoption of soil health measures	131
63	Adoption of Water conservation measures	132
64	Adoption of Preservation of natural resources	133
65	Difference among the districts in the preservation of natural resources	133
66	Adoption of ingredients of Productivity of farm	134
67	Adoption of profitable measures in Crop-husbandry	135
68	Adoption of recommendations leading to profitability of Animal Husbandry	136
69	Elements of Social Accessibility	137
70	Elements of Humaneness	137
71	Elements of Adaptability	138
72	Adoption and preference for sub-components of sustainability in agriculture	139
73	Suggestive social structure in order of importance	140
74	Cooperation mechanism for sustainability of agriculture in order of importance	141

Table No.	Title of the Table	Page No.
75	Evaluation of action for sustainability of agriculture in order of importance	142
76	Marketing network for sustainability of agriculture in order of importance	143
77	Suggestions to improve soil condition	145
78	Suggestions to preserve water	146
79	Suggestions to improve forest area	147
80	Suggestions to preserve animal wealth	147
81	Suggestions regarding profitable farming enterprise	148
82	Suggestions to strengthen extension system	149

LIST OF FIGURES

Figure No.	Title of the Figures	Page No.
1	Map showing the area of the study	57
2	Conceptual framework of the study	77
3	Relationship between profile of sample and level of perception	100
4	Relationship among factors of sustainability in agriculture with formation of perception	102
5	Perception about sustainability of agriculture	114
6	Sustainable Agriculture Index of villages under study	115
7	Sustainable Agriculture Index	116
8	Factors of sustainability of agriculture	129

OPERATIONALISATION OF TERMS USED IN THE STUDY

Accommodation:	It is the temporary working agreement between conflicting individuals and groups.
Adaptability:	Refers to capability of farmers in adjusting to the constantly changing conditions of farming.
Adoption:	It is the decision to continue full use of an innovation.
Attitude:	Tendency to act in some way towards some objects, person, situation or ideas.
Caste system:	It is a social category whose members are assigned a permanent status in a given social hierarchy by birth.
Caste:	A caste is the basic constituent of the caste system characterized by endogamous group, hereditary, occupation bound by tradition and arranged in hierarchical order.
Coastal ecosystem :	Coastal ecosystem has been operationalised as the districts adjacent to the sea areas having high rainfall and temperature.
Compassion:	Feelings of pity for the suffering of others.

Communication behaviour:	It is operationalised on the basis of exposure of respondents towards mass media like news paper, radio and television.
Cooperation:	It means working together towards common objectives or goal.
Conflict:	It arises when there is disagreement between two or more individuals or groups and each individual or group tries to gain acceptance of its need or objectives for other one.
Crop diversity :	This has been operationalised as the diversification of crops in the area, genetic diversity within the crop, use of nitrogen fixing crops / trees, raising green manuring crops and suitable cropping systems to derive maximum benefits causing minimum damage to the resource base.
Ecological soundness:	It refers to (a) maintenance of quality of natural resources and (b) enhancement of the vitality of the entire agro-eco-system.
Economic viability:	It refers to the degree to which agriculture is monetarily profitable.
Ecosystem:	Any collection of organisms that interact along with the physical environment in which they live, form an ecological system or ecosystem.

Equity:	It refers to how evenly the product of agro-ecosystem are distributed among the local producers and consumers.
Equitable:	fair and reasonable
Honourable living:	It is resultant outcome of fairness, empathy and integrity. Honourable living is about accomplishment not achievement.
Humanness:	It refers to the respect for all forms of human life, recognition of the fundamental dignity of all human beings, incorporation of basic human values like honesty, trust, compassion, etc in all types of relationship and institutions, preservation and nurture of cultural and spiritual integrity.
Natural resources:	It refers to soil, water, animal wealth, forest and mountain in the study.
Participant observation:	Method of data collection in which the investigator conceals his/her real purpose in order to be accepted as a member of group or community.
Perception:	It is the source of one's knowledge in the world. It is a complex process by which an individual selectively absorbs or assimilates the stimuli in the environment and cognitively organizes the perceived information to make assessment about what is going on in one's environment.

Quota sampling:	It begins by dividing population into relevant strata such as age, gender, geographical location and some other attributes.
Sustainable Agriculture Index (SAI):	SAI has been operationalised on the basis of score obtained taking into consideration of five parameters.
Small Farm Production System:	The small farm production system is operationalised on the basis of land holding defined by Government of Orissa, taking into consideration the marginal and small farmers. (marginal farmers upto 1 ha of land and the small farmers 1 to 2 ha of land).
Social accessibility:	It refers to the degree to which resources, power etc are equally available to all the farmers of the village/ community.
Social solidarity:	Cohesiveness or unity in the society.
Stability:	Steady and unlikely to change.
Sustainable agriculture:	Sustainable agriculture is one which protects the natural resources over a long period by adopting the eco-friendly practices which aims at protecting the environment, provides basic food and fibre needs, economically viable and enhances quality of life.

Sustainability of Agriculture:

Sustainability of agriculture is the successful management of resources to satisfy changing human needs unlike maintaining or enhancing the quality of environment and conserving natural resources

Chapter - I

INTRODUCTION

INTRODUCTION

With increase of population, demand for basic needs has been steeply rising during the past decades in most of the developing countries of the world. The growing population needs food, clothing, shelter, fuel and fodder for them and their livestock. In India, 50 to 70% of the people are living in rural areas who neither have adequate land holdings nor alternate service opportunities to produce or procure these basic commodities.

The present day living demands quality life. The quality life can be maintained provided our surroundings remain intact or improved to provide means for better living. With increasing advancements in science and technology, we have manipulated our environment without paying adequate attention to consequences. The result has become so alarming that now all the countries of the world are trying to actualize the meaning and concept of sustainability. It is more so in case of agriculture as it forms core base of life supporting system.

The magnitude of manipulation varies from country to country depending upon level of development. It goes without saying that development and manipulation of environment are interrelated having positive and negative effects. To eradicate ill effects of manipulation, we need to understand the meaning of the actualizing of sustainability.

To illustrate ill effects of manipulation we observe that about one third of world's cropland is loosing topsoil leading to long-term effect on productivity. About 50% of world's rangeland is overgrazed leading to formation of desert. World wide, almost half of the crop grown land are degraded at light to moderate rate. The fodder needs of livestock in all the countries of the world now exceeded the sustainable yield of rangelands and other forage resources. The fodder demand in India is estimated to be

seven thousand million tonnes against which sustainable supply is only 540 million tonnes. According to an estimate, 30% of world's cropland is now losing top soils at a rate that is undermining its productivity leading to food scarcity. If this trend continues the world as a whole may face a dangerous situation, as it has been observed in country of Kazakhstan in Asia, Europe and Kenya and Somalia in Africa. It is surprising that the cropland area in coastal provinces of China because of top soil erosion and construction of factories and roads are going out of cultivation. Yield losses due to soil erosion records 80 million tonnes in African countries that need attention of the scientists.

Water scarcity is another ill effect of present system of development. Water scarcity is increasing whereas in each year 80 million additional people are striking their claims to the earth's water resources. The manifestation of this problem is observed in the drying of rivers in several countries of the world. The Amu Darya in Central Asia, the Yellow river in China, the Nile in Egypt, the Jordan in Israel, the Ganges in India and the Mekong in Indo-China have become victims of this problem. It is further coupled with falling of water tables due to over pumping. Northern China is drying for depletion of water leading to the closing of wells, which serve for drinking purposes. In Punjab, the food basket of India, the water table is falling by 0.6 m per year, forcing farmers to dig deeper and deeper. In the South east plains of USA, practicing irrigated agriculture the water pumped from the *Ogallala aquifer* with little recharge the farmers are forced to return to dry land farming.

According to FAO, 270 million hectares of land in the world are irrigated and consume 70% of world's total human induced water consumption. About half of the water used for agriculture in USA comes from underground, from which it is pumped to the surface. The same is the situation in Indo-Gangetic plains of India. The water depletion gathers more momentum leading to slow recharge and fall in water table. Over

80% of the captured water is used for irrigation in India, 13% to 15% goes to energy and industrial use and 4% to 5% is consumed for domestic purpose including that needed by livestock. In India, on an aggregate, the sufficiency of moisture in agriculture is alright now. India may become a moisture deficit state for the water for irrigation if the present state continues. (Katyal, 1997)

Forest is another important component of environment. It is reported that half of the forest are sinking due to mis-utilisation of forest resources. The earth's forest area, estimated at 5 billion hectares at the beginning of twentieth century has now reduced to 2.9 billion hectares. This forest loss is concentrated in developing countries. The ill effects of deforestation experienced disastrous flooding, alternation in rainfall cycle, reduction in natural vegetation and other natural calamities. The environmental scientists are in opinion that same trends on environmental degradation will reinforce each other that is synergetic effect. Such synergetic trends are described as often irreversible (Lester Brown, 2001)

Not only soil, water and forest but also fishery component has been seriously affected. According to an estimate, two thirds of oceanic fisheries are now being fished at or beyond their capacity. With excessive demand on fisheries, the world is witnessing collapse of fisheries all over the inland, coastal and oceanic fisheries and commercial fishing is under great threat. Damage to coral reefs, a breeding ground for fish in tropical and sub-tropical waters is also taking a toll.

Irrigation of salt rich arid and semi-arid lands has added environmental cost. **When** water use is excessive the underground water table rises and brings with it the **dissolved** salts from the lower region of soil to the surface. The process resulted in low **crop** yield, increasing evaporation, leading salt-coated surface on crop land. Estimates suggest that in Bangladesh, river delta salinization is significantly reducing the yields in

about one-third of crop land, while in the desert of South west US the figure approaches one-fourth.

Another major threat concerns to the scientists is disappearance of the species. The archaeological records show five great extinctions since life begun in the earth. We are now in the early stage of sixth great extinctions. Unlike the previous ones, which are caused by natural phenomena, this one will be of human origin. The world conservation Union (IUCN, 1975) has pointed out the large increase in the critically endangered species in all categories – bird species, mammal species, fish species, amphibians etc.

Over the last three decades global average temperature has risen from 13.99°C in 1969 – 1971 to 14.43°C during 1998 – 2000. If carbon dioxide concentration in atmosphere doubles pre-industrial level by the end of the century reaching 560 ppm the temperature will rise by 1.4°C to 5.8°C. This rise will lead to more extreme climatic events like heat waves, melting of ice, rising sea level and more destructive storms. In the Arctic ocean, sea ice is melting. This may lead to expansion of ocean at the expense of continents, with consequences such as inundation of coastal areas, salt-water inclusion and beach erosion.

The word 'Sustainability' is of recent importance with increasing consciousness among the scientists / planners and common people. Though the dictionary meaning of sustainability is 'keeping on efforts going continuously', 'ability to last out and keep from falling': sustainability with reference to agriculture refers to the capacity to remain productive while maintaining the resource base. Sustainable agriculture is the successful management of resources for satisfying changing human needs while maintaining or enhancing the quality of environment and conserving natural resources (TAC/ CGIAR, 1989).

Sustainability in agriculture is considered from two important considerations, i.e. (i) environmental conservation and (ii) Non-stagnant productivity. The non-stagnant productivity encompasses food grain availability and trend in agro-ecosystem consisting of irrigated area, coastal belt, rainfall area, hill and mountain areas. To have sustainable agriculture many key elements have been identified which enlists zero tillage crop waste management, organic matter recycling, soil enrichment, IPM, use of information technology and precision farming. To be very specific, agriculture is only sustainable if it ensures that today's development is not at the cost of tomorrow's prospects (World commission on economic development, 1987). Further, the commission also pointed out that major component of sustainable agriculture are economic profitability and environmental health. The round table on environment economy (1994) identified key acts of agricultural sustainability as (a) the impact on rural economy system within its capacity, (b) present and projected environment, (c) depletion of non-renewable resources, (d) diversity and innovated resource efficiency, (e) equitable distribution of benefits and (f) participatory productive systems and area of information and education for sustainable agriculture. To be more specific the eminent Agricultural scientist Swaminathan (1991) has enlisted as many as 15 parameters like Technological Appropriability, Economic Feasibility, Economic Viability, Environmental Soundness, Temporal Stability, Resource Use Efficiency, Local Adaptability, Social Acceptability, Social Sustainability, Political Tactness, Administrative Manageability, Cultural Desirability, Renewability, Equity and Productivity to define the operational aspect of sustainability.

The above scenario leads to conclude that manipulation of environment for development in agriculture has brought ill effects in all the components that constitute/ correlates agriculture. The manipulations can be arrested provided people gain sufficient

insight to the problem and make use of recommendations to preserve the same. The state of Orissa in the map of Indian agriculture is not exceptional to the problems emerging out of environmental degradation.

Orissa comprises of 4.47% of India's landmass and accounts for 3.58% of population of the country. Nearly 85% of the population living in rural areas, depend upon agriculture for livelihood. According to the estimate, a total of ground water resource in Orissa is 21,01,128 hector meter (2001). The gross annual draft for all use was 3,10,089 hector meter (2001). Therefore about 14.79% of ground water resources have been used in Orissa so far. The total cultivable land of the state is about 65.59 lakh hector of which 26.89% have been provided with irrigation facilities (2003-04) covering 40% of cultivable land. The state is divided into 10 agro-climatic zones on the basis of soil, weather and other characteristics. The land of Orissa is classified into low (25.6%), medium (33.6%) and uplands (40.8%) with different texture and structure of soil.

The state's economy is greatly influenced by agriculture, which contributes about 25.9% of NSDP (2003-04). With 39.66 lakh operational holdings, the small and marginal farmers account for 81.97%. About 80.27% of operated land is owned by small and marginal farmers. In the field of irrigation, forestry, fishery and animal resources the position of state is now in an improvement side. To support the development of the state, there is an urgent need to adopt recommendation for sustainable agriculture. The present problem of agriculture in coastal area is salinity, which comes to be 2,55,121 ha. The water logging areas (0.60 lakh ha) of the state is no less important to bring the attention of the policy makers for immediate solution. Out of the undivided 13 districts, Cuttack and Puri are the most affected area having as much as 21.36 and 13.95 thousand hectare under waterlogged condition respectively. The total waterlogged area of the state is reported to be 74.76 thousand hectare. The acid soils of the state covering laterites and

lateritic soil have abundance of iron that pose problems in agriculture. Highly acidic and alkaline soils limit crop growth and should be ameliorated for optimum crop production. In Orissa high acidic lateritic soils are observed in Cuttack, Puri, part of Balasore, Ganjam and Dhenkanal (pH 4.0 to 6.5). Sand dunes in coastal Orissa is another important problem due to strong prevalence of wind. The duned lands have poorest soil from agriculture point of view. The undivided districts like Cuttack, Balasore, Puri and Ganjam had sand duned area to an extent of 56298.40 ha. Strip land along roadside as well as rail line can be used for growth of agriculture of the state.

The above-mentioned situation of the state needs urgently to plan for sustainable agriculture. The farmers of Orissa are required to have insight into problem so that attempts of the Government can bear the success whenever sustainable measures are put into action. Keeping above considerations in view a study titled “Factors affecting sustainability of agriculture under small farm production system in coastal ecosystem of Orissa” was designed to understand the status of agriculture sustainability in Orissa in general and the following objectives in particular.

Objectives:

1. To study the socio-economic and farming related factors of the sample selected for study.
2. To measure the perception of small farm operators about elements of sustainability of agriculture and gap in comprehending sustainability.
3. To determine the relative position of area under Sustainable Agriculture Index.
4. To determine the relative position of sub-components of factors of sustainability of agriculture as perceived by the sample under study.
5. To study the pattern of adoption of recommended measures of sustainability of agriculture.

6. To find out effective extension approaches for enhancing sustainability of agriculture to provide better living standard to farmers at large.
7. To find out suggestions and formulate strategy for preservation and maintenance of sustainability of agriculture.

Scope and importance of the study:

The study makes an effort to analyze socio-economic and farming related factors of the small farm operators. The study has attempted to investigate into the perception of the sample about sustainability of agriculture on five important parameters like, ecological soundness, economic viability, social accessibility, humaneness and adaptability. The existing gap comprehending the sustainability of agriculture, Sustainable Agriculture Index (SAI) of the area as well as the relative position of sub-components of factors of sustainability as per reaction of the sample farmers under study. There are recommended measures of sustainability of agriculture. In this regard the adoption of recommended measures, extension elements as well as suggestions for sustainability of agriculture have been analyzed with appropriate statistical tools. The findings of the study would form a base for development agencies in formulation and implementation of the programmes for sustainability of agriculture in the state. The investigation has been designed to find out effective extension approaches. The suggestions regarding preservation and maintenance of sustainability have been recommended as per the perception of experts and farmers. Thus, the information generated through the study adds to the already available recommendations for sustainability issue in field of agriculture and allied sectors in the state. The assumption is that the results of the study would be useful to the planners, executives and field functionaries in designing appropriate programme and effective implementation of the programmes on sustainability of agriculture in the state.

Limitations of the study:

The study entitled “Factors affecting sustainability of agriculture under small farm production system in coastal ecosystem of Orissa” involves analysis of opinions offered by farmers at ground level who constitute primary sources. Further, use of the secondary data have been incorporated wherever applicable to support the analysis and drawing of conclusion. The study is based on the data derived from the primary and secondary sources. Since the study was conducted in four districts of the state namely Puri, Khurda, Ganjam and Balasore with distinct agro-ecological features, the findings may not have similar applicability in other area of the state. The paucity of funds, time and other limitations did not allow to cover entire state. However, the inference drawn from the study will be of great importance for the scholars in this line of research and field workers to design programmes on sustainability in agriculture.

Organisation of thesis:

The thesis contained six chapters, namely Introduction, Review of literature, Orissa at a glance, Research methodology, Results and Discussion, Summary and conclusion with required appendices to fulfill the requirements of international standard.

Chapter - II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The study entitled "Factors affecting sustainability of agriculture in small farm production system in coastal ecosystem of Orissa" is of multidisciplinary in nature. Both social science and field related sciences are merged together to present views about sustainability of agriculture in general and ecological aspects in particular. In course of review of literature studies from different disciplines were collected and examined. Their relevance with present study keeping in view of multidisciplinary nature, the collected literatures have been arranged under the following heads.

1. The concept, meaning and definition of sustainability of agriculture
2. Knowledge, perception and attitude about sustainability of agriculture
3. Ingredients that define the sustainability of agriculture
4. Adoption of recommended measures of sustainable agriculture
5. Extension and communication approaches for enhancing sustainability of agriculture
6. Suggestions and strategy for maintenance and preservation of sustainability of agriculture

1. Concept, meaning and definition of sustainability of agriculture

According to Gips (1986) sustainable agriculture is one, which is ecologically sound, economically viable, socially just humane and adaptable.

Brundtland Commission (1987) opined that sustainability is essentially a holistic notion at which one can exploit exhaustible resources or the level of degradation of renewable resources that may be permitted.

According to the "International Green Front Report" (1988), "Sustainable agriculture is a broad term which includes organic farming, permaculture, bio-dynamic farming and other forms of progressive agriculture where by the farm and surrounding ecosystems are enriched rather than impoverished.

TAC/ CGIAR (1989) reported that sustainable agriculture is the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources.

Reetz (1990) stated that Sustainable agriculture is the system that is profitable and environmentally sound. Sustainable and conventional agriculture can be one and the same.

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

According to Swaminathan (1991), Sustainable agriculture has following dimensions. Technological appropriability (how far the agriculture technology be it a seed, fertilizer, pesticide or improved machinery suits the social and infrastructural situation of the end users). Economic feasibility (the capacity of farmers to afford to incorporate the technology in his farm within his realm of financial status and position), Economic viability (the return to investment of every rupee counts), Environmental soundness (whether technology results in enriching the environment or at least doesn't harm the existing agro-ecological conditions), Temporal stability (whether the positive aspect remain stable over the long run), Resource use efficiency (how efficiently the technology can utilize the inputs to convert them into useful, productive and eco-friendly output), Local adaptability (the extent to which the technology is adaptable to the existing local condition of the farmers). Social acceptability (the extent to which the technology is acceptable by different sector of the society), Social sustainability (has to meet the personal needs), Political tact ness (whether the technology can be used unharmed in the existing intricacies and implications of political setup), Administrative manageability (the extent to which the technology can be practically implemented under the existing bureaucratic structure), Cultural desirability (the extent of the technology fits with the culture patterns and values of the society), Renewability (the extent to which the technology can be used or reused without much additional efforts or inputs), Equity (how evenly the product of agro-ecosystem are distributed among the local producers and

consumers) and Productivity (the rate and amount of production per unit of land or input). It also measures sustainability of agriculture.

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

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

Izac *et. al.*(1992) reported that sustainable agriculture contains three equally important components namely environmental quality and ecological soundness, plant and animal productivity and socio-economic viability indicating the quality of life and profitability for farmers, farm workers and rural communities.

Katyal *et. al.* (1992) pointed out that sustainable agriculture revolves around the use of low cost inputs, less dependence on chemical fertilizers, maintenance of soil fertility and ecological harmony, preservation and enhancement of biological productivity.

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

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

and input used), security (minimizing risk of production), continuity (maintaining soil and water health) and identity (self respect, social justness and humaneness). Feeling of identity is maintained by technologies that permit to be self reliant and to control decision making about use of local resources and products.

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

Mendoza (1994) expressed that any agricultural system to be identified as sustainable one must achieve, if not all of the objectives like, increased productivity, profitability and economic well being of farmers, preservation of environmental quality, self sufficiency of food, equitable distribution of economic returns and optimal utilization of internal resources produced on farm.

Stockle *et al.* (1994) concluded that all definitions of sustainable agriculture include food productivity, safety, resource protection, quality of life and environmental quality specifically emphasizing on attributes like profitability, productivity, soil, water and air quality, energy efficiency, fish and wild life habitat, quality of life and social acceptance.

Chakraborty *et al.* (1995) remarked that the essence of sustainable technology is one which is economically viable, dynamic in nature, adaptable, acceptable to farmers, prevent degradation or excessive loss of soil, water, nutrients and conserve

resources for future generation, avoid over exploitation of land with genetic diversity and ecological integrity ensuring good health and vitality of people.

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

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

Vijaya (1996) opined that sustainable agriculture can be referred to as alternate farming or conservation farming or regenerative agriculture or organic farming for accepting the principle of co-existence of soil microbes livestock and free component which leads to natural farming for future prosperity.

Yadav *et. al.* (1996) found that the harmony between increasing production through advanced agro technology for the present and preservation of environmental quality and resource base for the future led to the concept of sustainable agriculture. It aims at stability of production overtime through the location and situation specific production principles.

Agarwal (1997) stated that eco-sustainable agriculture is linked to carrying capacity of the ecosystem based on the development planning process by analysing

the underlying correlationship between, population, poverty and pollution to provide supportive capacity for development and assimilative capacity for maintenance of acceptable quality of environment.

Lahiry (1997) stated that sustainable development is a multidimensional concept with three interacting angles of ecology, economics and ethics, the necessary conditions for achieving sustainable development, ecological security, economic ability and social equity. Sustainable agriculture calls for an environmental friendly technology at the global level and agreement among the nations to respect each others need.

Nagabhusanam (1997) reported that crop diversity, land productivity, input use index, integrated pest management, eco-system management, soil environment level, crop productivity, enterprise supporting ability, social equity, and carrying capacity are some of the important indicators of sustainability of agriculture.

Sadangi (1997) found that the adoption of proven alternative system would result on even greater economic benefits to farmers and environmental gains for the state and the economy.

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

Verma and Agarwal (1997) reported that economics of sustainable development is the development that last. It means the need of the present without compromising the ability of future generations to meet their needs.

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

Swaminathan (2000) emphasised on the major components of integrated natural resource management of integrated gene management, integrated nutrient management / supply, efficient water management, soil health care, integrated pest management and efficient post harvest management.

Fadini and Lauzada (2001) stated factors determining biodiversity in agro-ecosystem. The importance is emphasized on replacing harmful agricultures practices with less damaging practices as a way of achieving sustainable agriculture.

Hasbi (2001) opined three important points in sustainable agriculture i.e. the cultivation system, organic and natural fertilizers, microorganisms and erosion control.

Jitsenguan (2001) described five sustainable farming systems for small-scale farmers and their profitability i.e. (i) integrated farming, (ii) organic farming, (iii) natural farming, (iv) agroforestry and (v) new theory farming. All these were

promoted as alternative agriculture to small Thai farmers. It was shown that sustainable agriculture was not only financially viable but also enhanced environmental quality, for the benefit of farmers.

Rai *et. al.* (2001) stated that management practices for sustainable agriculture differs from those of modern agriculture and recommended important steps for suitable agriculture like (i) watershed management, (ii) integrated development and conservation of genetic resources, (iii) agro-forestry, (iv) integrated nutrient management, (v) tillage, (vi) ground water management, (vii) remote sensing in management of natural resources and (viii) integrated pest management.

Sharma (2003) opined that simplified processes sustained for long time while more dependence on external inputs (exotic plants, seeds, nutrients, irrigation etc.) increase cost and reduce sustainability.

Sabarathnam (2002) emphasized five factors for sustainable agriculture as Ecological soundness, economic viability, social accessibility, humanness and adaptability.

Rai (2005) remarked that sustainable development of agriculture in the 21st century depends largely on the emerging technologies in agricultural and found encouraging. Agricultural fields vary with space and time and hence required site specific crop management for maximizing the efficiency of the input resources.

2. Knowledge, perception and attitude about sustainability of agriculture

Nirmala *et. al.* stated that nearly half (42.83) of the farmers were found to possess a high level of knowledge followed by medium (32.50%) and low (21.67%) knowledge on bio-fertilizers.

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

Padmavathi (1996) observed that 65.50% of Mitrakissans had favorable attitude followed by 18.88% and 15.56% with high and less favourable attitude towards national watershed Development project for Rainfed Area (NWDPRRA).

Reddy (1996) found that majority (55.83) of the vegetable growers had medium knowledge followed by high (26.65) and low (17.29%) levels of knowledge respectively.

Jirli and Gangadharappa (1997) stated that nearly half (45.00%) of the farmers were found to possess a medium level of knowledge followed by high (31.00%) and low (20.00%) knowledge with respect to integrated pest management of vegetable cultivation.

Rambabu (1997) indicated that majority of the respondents (70.10%) had favourable attitude towards indigenous technology items in wet cropping system followed by neutral attitude (13.34%), unfavourable attitude (8.33), highly favourable attitude (5.10%) and highly unfavorable attitude (3.33%). In dry cropping

system majority of respondent (66.67%) had favourable attitude towards indigenous technology items followed by unfavourable attitude (11.67%) and neutral attitude (5.00%). On an average majority of the respondents (73.34%) had favourable attitude towards indigenous technology items followed by 10.00% each of neutral and unfavourable attitude, and 3.33% each of highly favourable and highly unfavourable attitude.

Singh (1997) reported that 55.00% of respondents had a favourable attitude and 5% a highly favourable attitude towards the social forestry programme.

Bhople and Lakhdive (1998) revealed that more than 50% of the farmers knew the IMP practices.

Manjunath *et. al.* (1998) indicated that majority of the farmers had perceived the practices of green manuring as simple, not risky, useful, but costly and not triable.

Srivastava (1998) opined that majority of the farmers had a favourable attitude towards improved farm implements.

Alagesan (1999) stated that about two thirds (61.67%) of the respondents had knowledge about azospirilum, followed by rhizobium. The knowledge on other bio-fertilizers by the farmers was less than 5.00%. Farmers have limited knowledge on parasite and predators ranging from 0.83% to 9.13% with respect to bio-fungicides only 6.67% of farmers had knowledge on *Trichoderma viridae*.

Haque *et. al.*(1999) informed that 52% of farmers had a medium level of knowledge followed by 37.00% had a high knowledge level and 11.00% had a low knowledge level.

Khan (1999) indicated that more than three fourth (77.77%) of the respondents were having medium knowledge on eco-friendly technologies in rice cultivation while 13.34% and 8.89% had high and low knowledge respectively.

Kumar *et. al.* (1999) indicated that many of the farmers were neutral or undecided in their attitudes towards agro-forestry programme.

Nagdeve (1999) informed that majority (68.67%) of the respondents had moderately favourable attitude, while 16.66% had more favourable attitude and 14.67% respondents had less favourable attitude.

Nagdeve (1999) revealed that majority (71.33%) had medium knowledge, while 12.67% had low knowledge and 16.00% of the respondents possessed high knowledge.

Ohlander *et. al.* (1999) indicated that future agricultural system should be aimed at goal oriented sustainable management of ecosystem.

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

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

Cothe and Barker (2000) stated that more than half (58.67%) of the respondents had medium level of knowledge followed by high (22.67%) and low (18.66%) knowledge level of bio-fertilizers.

Prasad and Sundaraswamy (2000) observed that 36.67% of the respondents belonged to less favourable attitude category followed by 34.33% belonged to more favourable category. A significant percentage (29.00%) of respondents belonged favourable category.

Resmy *et. al.* (2000) observed that majority of small farmers and big farmers had medium level of knowledge. In case of small farmers it was followed by high level of knowledge and then low level of knowledge where as an equal percentage (25.00%) was seen to be distributed under high level of knowledge in case of big farmers.

Ramamurthy (2000) indicated that 72.50% of the respondents had favourable attitude followed by 11.67% with more favourable attitude and 15.83% with less favourable attitude towards Janmabhoomi Programme.

Raj and Satpathy (2003) found that the watershed beneficiaries agreed that, available resources, development of team work, good linkage with related departments adoption of improved technology can increase production and productivity.

3. Ingredients that define the sustainability of agriculture

Altieri (1992) opined that key strategy in sustainable agriculture is to restore the agricultural diversity of the agricultural landscape. Diversity can be enhanced in time through crop rotation and sequences, cover crops, intercropping, agro-forestry and crop/ live-stock mixture without damaging the environment or depleting natural resources for future generations. Social and economic conditions in subsistence agriculture may preclude reliance upon costly or dangerous supplements such as expensive equipment, commercial fertilizers and pesticides.

Dunlap *et. al.* (1992) reported nine dimensions viz. protect and enhance soil health, ensure supply of safe and whole food, improve site specific knowledge of farmers, enhanced environment and wild life habitat, increased diversity, improved farm economy, reduced agrochemical use, reduced energy use and reduced purchase of inputs have been considered as most important in explaining the concept of sustainable agriculture.

Loker (1994) reported that low external input agro-forestry systems (a specialized form of low input sustainable agriculture system of LISA) hold great

promise as alternative sustainable production systems for small to medium farmers in humid tropics.

Jayashree and Prasad (1994) analysed different dimensions of sustainable agriculture and identified different dimensions which include technological appropriability, economic feasibility, environmental soundness, temporal stability, resource use efficiency, local adaptability, social accessibility, political tactness, administrative manageability, cultural credibility and renewability.

Lawrence (1994) proposed the indicators for sustainable agriculture and as a guide to evaluating appropriate technologies are (1) ecological indicators (2) economic indicators and (3) social indicators.

Cai and Smith (1994) opined that sustainable agriculture should combine all the components of sound husbandry into united packages.

Kutty (1996) reported the important dimensions of sustainable agriculture. Six dimensions adorned the top position. They are resource use efficiency, environmental soundness, economic viability, technological appropriability, economic feasibility and local adaptability.

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

Elangovan and Vasantakumar (1997) studied the usefulness index of different eco-friendly technologies as perceived by extension officers which includes 1 PM and bio-fertilizer application, FYM, green manure and neem cake application, compost application and integrated farming systems, forestation, neem seed kernel extract application, composted coir pith, vermin-compost, rice-fish-azolla culture.

Barad *et. al.* (1998) indicated that improved crop production technologies, organic farming, alternative land use systems including agro-forestry systems, watershed management, cultivation of less economic plants, biological control, integrated pest management, utilization of wastelands, and use of biological wastes in agriculture as the vital ingredients of agricultural sustainability.

Jalali *et. al.* (1998) reported the non target impact of pesticides, the parameters governing integrated disease management, the relevance of biological control, the biotechnology and disease management in reference to plant pathogens.

Koocheki *et. al.* (1998) revealed that a wide range of criteria were evaluated, including climatic, edaphic, cultural practices, agro-biodiversity, extension and education, demographic factors, financial issues and marketing for having sustainability of agriculture.

Kern and Geiss (1999) recommended that main issues of sustainability in agriculture are protecting and improvement of agricultural resources i.e. preserving and restoring soil and water quality which is best met through integrated crop management practices.

Singh *et. al.* (1999) reported that enhancement of genetic diversity, conservation tillage, improved level management, integrated pest management and integrated water-management systems are some of the important dimensions of sustainable agriculture.

Dabrowski (2000) stated that the recent shift from concept of Integrated Pest Management (IPM) as Intelligent Pesticide Management to ecologically based pest management to meet the long term goals of safe, economically viable and sustainable agriculture, require development of new interaction between farmers, extensionists, researchers and policy makers.

Paroda (2000) indicated that to remain relevant and efficient there is a need for paradigm shift from commodity centered to an ecologically, economically and socially sustainable farming system centered approach to agricultural research (crops, livestock, fish, forestry and agro-forestry) and organising education, extension and skill empowerment on the basis of farming system intensification, diversification and value addition.

Anderson (2000) opined that past and current failure to replenish soil nutrient in low income countries must be rectified through the balance and efficient use of organic and inorganic plant nutrient and through improved soil management practices.

Swaminathan (2000) stated that the evergreen revolution would be triggered by farming systems, that can help produce more than the available land, water and labour resources without their ecological or social harm.

Singh (2001) concluded that predominance of small scale agriculture necessitates a synergetic integration of crop, live stock and environment at farm level in the region to region as a long term strategy.

Al Jaloud *et. al.* (2002) opined that there exists an excellent potential for a renewable crop production if certain soil water and crop management practices are considered in an arid environment.

Bhavsar (2002) opined certified organic food and fibre production as an important part of the agricultural economy.

Bussche (2002) indicated that in agriculture sustainable development should however not be equated with organic farming. Given appropriate management, both farming systems organic as well as conventional farming can be ecologically and socially sustainable.

Cox *et. al.* (2002) emphasized that high water use efficiency is needed to minimize the overuse of sea water resource.

Eichhorn *et. al.* (2002) emphasized the importance of agricultural engineering in sustainable agriculture that involves the technical adoption for sustainable soil protection, energy cost sparing production procedures in crop production, pastoral

management and care of the countryside including recycling of residual biological material.

According to Gelderman and Kogel (2002) solution of sustainable agriculture is more than ever a scientific development of tools for a sensible management of resources.

Jonson (2002) emphasized the Integrated Production (IP) rules that have to be followed on entire farm state and crop protection showed be based on preventive and cultural methods. Biological control methods showed be given priority, the use of pesticides should be minimized through monitoring of pests.

Kassa *et. al.* (2002) opined that any agricultural development initiative in Ethiopia must include both crop and live stock components for success.

Liu *et. al.* (2002) found that after 20 years of soil conservation and restoration, the ecosystem health index of the watershed had improved from 0.178 in 1985 to 0.707 in 1999.

Yadav (2004) reported that in developing countries sustainable resources management, increased crop yields without much reliance on costly external inputs, environmental and biodiversity protection through organic farming taking care of soil quality, water quality and air quality as well as energy use would maintain sustainability in crop production.

4. Adoption of recommended measures of sustainable agriculture

Muthuraman (1995) stated that 40.00% the farmers interviewed were medium adoptors and about 30% of each of them belonged to low and high adoptor categories in adoption of farm yard manure, with respect to green manuring 40.00% of farmers were in low, 44.00% of them in medium and only 16.00% of them were in high categories.

Nirmala *et. al.* (1995) reported from their study that majority of the farmers (54.17%) were found in low level of overall adoption followed by one fourth (25.00%) in medium and one-fifth (20.83%) in high level of adoption of bio-fertilizers.

Khan (1999) indicated that majority (70.00) of the respondents belonged to the medium category of adoption followed by low (15.50%) and high (14.44%) category with respect to the adoption of eco-friendly technologies in rice cultivation.

Manjunath *et. al.* (1999) observed that 36.00 % of the sugarcane growers had low adoption followed by 34.00% each were observed under high and medium adoption level of sustainable sugarcane farming practices of sugarcane.

Nagdeve (1999) reported that majority (68.00%) had medium adoption, while 16.67% had low adoption and 15.23% respondents had high adoption of IPM practices.

Sriram and Palaniswamy (1999) informed that 39.16% of the cotton growers belong to medium level of adoption followed by high (35.84%) and low (25.00%) level of adoption of eco-friendly agricultural practices in cotton cultivation.

Cothe and Barker (2000) reported that majority of farmers had medium level of adoption followed by high (32.00%) and low (26.00%) level of adoption of bio-fertilizers.

Dhillon (2000) informed that majority of respondents had medium level of awareness and adoption regarding agricultural pollution in Punjab.

Saxena and Singh (2000) concluded that majority of the farmers belonged medium level of adoption category who are following 5 to 7 out of 10 organic farming practices, whereas only 25.00% of the farmers were following more than seven kinds of organic farming practices.

Siddiq (2000) recommended that development and extensive adoption of location specific forming systems aiming at higher productivity, better return and year round employment would alone help improve the quality life of those inhabiting in the long neglected ecology.

Sumathi and Alagesan (2000) informed that nearly little less than half (41.00%) of the farmers had medium level of adoption followed by 35.00 percent at low level and 25.00% at high level.

Bhople *et. al.* (2001) found that majority of the respondents (81.33%) had low level of adoption of bio-control practices for pest management in cotton followed by medium (16.67%) and high (2.00%) levels.

Kadam *et. al.* (2001) observed that majority (68.00%) of the beneficiaries had adopted only one practice, namely, 'dividing fields with small bunds'. The practices namely, 'Stable and agro-waste plucking' (38.66%), and small earthen bunds (23.33%) were also adopted by a considerable number of the beneficiaries.

Kalaskar *et.al.* (2001) revealed that majority of the respondents (67.27%) were moderately aware about different IPM practices in cotton. In other words it could be stated that quite a few (16.97%) respondents have high level of knowledge about IPM practices.

Cox *et. al.* (2002) stated that to maximise the adoption by farmers, water use efficiency must be based on easily measured parameters.

Bautista (2003) informed that the introduction and adoption of mechanised system should also consider selective mechanisation for suitable operations, socio-economic factors, as well as environmental consensus.

Singh and Singh (2004) opined that sustainable development has become key word in every policy of Government. But in present population explosion scenario it is important to provide alternative means to the ever increasing population otherwise all policies will be eye wash only.

5. Extension and communication approaches for enhancing sustainability of agriculture:

Padhee (1995) reported that non-availability of required inputs, lack of extension efforts and methodology directed towards small farmers, restricted access to institutional credit facilities, and the suspicions of farmers regarding IPM recommendations.

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

Rambabu (1997) indicated that lack of more supporting price to the quality products was the major constraints in wet cropping system followed by lack of good grading facilities in dry and garden cropping system. Lack of publications on proven indigenous technologies, lack of proper training facilities and lack of organized extension machinery to disseminate the proven indigenous technologies were the major constraints in wet, dry and garden cropping systems respectively.

Pornthip (1998) reported that the people's actual participation and involvement in the activity of community forest management is at low level.

Lakhan *et. al.* (1999) reported that the major constraints identified were lack of trained staff, time limitation, lack of co-operation from villagers at initial stage while formulating village development plan, shortage of staff and excessive work load, frequent interference by community representatives in project and lack of faith among villagers, quick planning and poor rapport, while eliciting peoples participation.

Nagdeve (1999) revealed that in respect of socio-economic constraints, the most important constraints were : lack of credit facilities, high cost of inputs, and higher interest on credits. With regard to communication constraints, most important constraints were lack of precise information from charge agents and difficulty to contact the extension agency at the time of need.

6. Suggestions for maintenance and preservation of sustainability of agriculture

Padhee (1995) reported that education of farmers, I PM research, effective extension network and government policy were essential for development of agriculture.

Reddy (1996) opined that forming user and self-help groups in each village, making proper follow up actions by officials, local communications, institutions and leaders must be encouraged to involve in analyzing the problems and interests of people, implementing agency should intensify its extension activities to motivate the

farmers' involvement in programme, timely supply of critical inputs and implements, giving equal representation to all categories of farmers in watershed society, provision of timely technical guidance by scientists, provide credit facilities to the needy farmers, giving much emphasis on horticulture and income generating activities in programme, organizing training programmes to all beneficiaries on all components of programme, watershed officials should support indigenous technologies, constructing more number of farm ponds and percolation tanks in the areas, and entrusting the development of community lands to village institutions were the suggestions given by the farmers to improve their participation in watershed development programme.

Rambabu (1997) revealed that the important suggestions made by the farmers to overcome the constraints were improvement of sound research on ecological farming practices, make available the bio-fertilisers and neem products on subsidized rates by government, establishment of bio-gas plants for getting more organic manure and strengthening the extension system to immediate dissemination of proven indigenous technologies.

Shinde *et al.* (1997) inferred that cent percent of cotton growers suggested to provide delinted and certified seeds of cotton to prevent initial pest infestation, followed by more than 90.00% of them suggesting to provide a kit comprising magnifying lens to observe the eggs and larvae on the leaves, literature having details about the IPM practices, pheromone traps to monitor the pest occurrence facilitating the control through neem seed undertaken by them and make available the neem seed

kernel to promote its use against the boll-worm as the important recommendations in IPM programme.

Nagdeve (1999) revealed that the important suggestions made by the IPM trained farmers to overcome the constraints were timely supply of inputs at reasonable cost, regular farm visit of extension workers, arranging more credit facilities, less rate of interest on loan, providing the subsidy on inputs. Timely technical guidance, organizing more number of training programmes and follow up training programmes for successful implementation of IPM programme and thereby improve the plant protection status of the farmers were also suggested.

Pornthip (1998) recommended that the key persons of the various groups should be educated so that they would perceive the importance of establishing the organizations to take the charge of looking after village's forest expecting that these key persons would further lead their group members to have greater awareness and participation in the project activity for sustained forest management.

Raju and Radhakrishna (2000) observed that the respondents suggested ways to overcome the constraints in betel vine cultivation by exact control measures of diseases and pests, continuous power supply, timely technical guidance, frequent monitoring of technical staff, maintaining demonstration plots, provision of fertilizers on subsidy, release of cyclone resistant varieties, conducting training programmes, increase the price of farm produce, supply of effective plant protection chemicals, providing bank loans, establishing nearby soil testing laboratories and establishment of nearby collection centers in the order.

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

Swaminathan (2000) opined that the future belongs to small farm families taking to precision agriculture, involving the use of right inputs at the right time and in the right way. He also suggested that eco-technology based precision farming could help cut costs, enhance marketable surplus and eliminate geographical risks. This is the pathway to an evergreen revolution in small farm agriculture.

Flora (2001) indicated that attention to differences within the communities was important in working towards sustainability of an agro-ecosystem. Efforts to build social capital among women proved critical in developing both collective and household strategies for sustainability.

Singh (2004) recommended that the use of insecticides, fungicides and herbicides of plant origin was needed and their extract was recommended. This would go long way in providing semblances and equilibrium in the agricultural ecosystem and environment as a whole.

Chapter - III

ORISSA AT A GLANCE

ORISSA AT A GLANCE

1. Brief description of the state

The study was undertaken in the state of Orissa. The state lies in between 17° 31' to 22° 27' North latitude and 81° 27' to 87° 30' East longitude. It is bounded by West Bengal in the North East, Jharkhand in the North, Chhatisgarh in the West, Andhra Pradesh in the South and Bay of Bengal in the East. The main features of the state are given in Table 1.

Table 1: Orissa at a glance (2001 census)

Sl. No.	Facts	Unit	Magnitude
1	Geographical situation	-	Between 17° 31' to 22° 27' North latitude and 81° 27' to 87° 30' East longitude
2	Geographical area	Sq. km.	1,55,707
3.	Population	Number	3,67,06,920
4.	Male population	Number	1,86,12,340 (50.71%)
5.	Female population	Number	1,80,94,580 (49.29%)
6.	Density of population	Persons/sq.km.	236
7.	Literacy rate	Percentage	63.61
8.	Male literacy rate	Percentage	75.95
9.	Female literacy rate	Percentage	50.97
10.	Sex ratio	Female/ 1000 males	972

Source : Economic survey : Directorate of Economics and statistics, Orissa – 2001) P-ANX 15-61.

2. Physiography of the state

Orissa is an extensive plateau, which slopes gently into coastal plain along the Bay of Bengal. The river Mahanadi is flowing west to east through the plateau divide the state into two definite parts. The Northern part is an extension of Chhotnagpur plateau and the southern part is a part of Eastern Ghat region.

The state has been divided into ten agro-climatic zones. The distinctive features of various zones are as follows.

i. North Western Plateau

The zone comprises of agricultural districts of Sundergarh, Baneigarh and Panposh in Sundergarh revenue district and Kuchinda under Sambalpur district. The climate is hot, moist and sub-humid having mean annual rainfall of 1600 mm, mean maximum temperature of 38°C and mean minimum temperature of 15°C . The soil is light textured with red and yellow soils. Major crops grown are rice, toria, wheat and vegetables.

ii. North Central Plateau

It consists of the agricultural districts Rairangpur, Baripada, Karanjia in Mayurbhanj district and Champua in Keonjhar district. The climate of the zone is hot, moist and sub-humid. The mean annual rainfall is 1534 with mean maximum and mean minimum temperature of 36.6°C and 11.1°C respectively. Red loam and light textured soils mostly found in the zone. Rice, niger, maize, horse gram, black gram, arhar, sesamum and vegetables are the major crops grown.

iii. North Eastern Coastal Plain

Agricultural district Anandpur under Keonjhar district, Balasore and Bhadrakh districts are coming under this zone. The climate of the zone is moist and sub-humid with mean annual rainfall of 1568 mm. The mean maximum temperature is 36°C and

mean minimum temperature is 14.8°C . Alluvial soils and narrow strip of sedimentary sandy loam to clay textured soils are the characteristics of this zone. Major crops grown are rice, jute, groundnut, toria, vegetables, black gram, green gram and betel vine.

iv. East and South Eastern Coastal Plain

Cuttack and Banki agricultural districts in Cuttack district, Jagatsinghpur, Kendrapara, Puri district, Khurda agricultural district in Khurda district and Berhampur, Chhatrapur agricultural districts in Ganjam district comprises this zone. The climate is hot and humid with mean rainfall 1577 mm and means maximum as well as mean minimum temperature of 39°C and 11.5°C respectively. The soils of the zone are mainly loam, clay loam and coastal alluvial with a narrow strip of saline inundated areas. Rice, green gram, black gram, groundnut, jute, sesamum and vegetables are the major crops grown in this zone.

v. North Eastern Ghat

The zone consists of Khurda, Nayagarh, Kandhamal, Boudh, Gajapati districts, Rayagada and Gunupur agricultural districts in Rayagada district and Aska agricultural district in Ganjam district. The climate of the zone is hot, moist and sub-humid with mean annual rainfall of 1597 mm. The mean maximum and minimum temperature of this zone is 37°C and 10.4°C respectively. The soils of the zone are brown forest soil, sandy loam, loamy and clay with medium texture. Rice, ragi, black gram, green gram, til, groundnut, sugarcane, toria, turmeric and vegetables are the major crops grown in this zone.

vi. Eastern Ghat High Land

Koraput, Nawarangpur district except Dabugaon area are under this zone. The climate is warm and humid with mean annual rainfall of 1521.8 mm. The mean maximum and minimum temperature are 34.1°C and 7.5°C respectively. The zone consists mostly red

soils with low organic matter content. Major crops like ragi, rice, small millets, vegetables, maize, arhar, niger, toria and sweet potato are grown in this zone.

vii. South Eastern Ghat

The agricultural district Jeypore in Koraput district and Malkangiri district are included in this zone. The zone is having warm and humid climate. The mean annual rainfall, maximum and minimum temperature are 1710.4 mm, 34.1⁰C and 13.2⁰C respectively. Red and Red yellow mixed soils are the characteristics of this zone. Rice, arhar, niger, toria, maize, sweet potato and vegetables are the major crops grown.

viii. Western Undulating Zone

The zone comprises of the agricultural districts Bhawanipatna, Dharmagarh in Kalahandi district, Padmapur in Bolangir district, Khariar in Nawapara district and Dabugaon areas of Nawarangapur district. Hot, moist and sub-humid climate with mean annual rainfall of 1352.3 mm is the main features of the zone. The mean maximum and mean minimum temperature are 37.8⁰C and 11.9⁰C respectively. Black, heavy light soils and mixed red black soil with medium to heavy texture are found in this zone. Rice, ragi, arhar, bengal gram, toria, onion, cotton, vegetables and groundnut are the major crops grown in this zone.

ix. Western Central Table Land

Sambalpur, Baragarh, Bolangir and Sonepur districts belong to this zone. The climate is hot, moist and sub-humid with mean maximum temperature of 40⁰C and mean minimum temperature of 12.4⁰C. Red, heavy textured calcareous and light to medium textured soils are mostly seen in this zone. Average annual rainfall is 1282 mm. Major crops grown are rice, til, black ram, wheat, green gram, groundnut, sugarcane and vegetables.

x. Mid-Central Table Land

The zone consists of agricultural districts of Dhenkanal in Dhenkanal district, Angul and Kamakhyanagar in Angul district, Banki and Athagarh in Cuttack district and Sukinda block in Jajpur district. The climate of the zone is hot, dry and sub-humid. The mean annual rainfall is 1421 mm with mean maximum and mean minimum temperature of 38.7°C and 14°C respectively. Light textured, lateritic, medium textured, red loam, mixed red and black soils are found in this zone. Rice, groundnut, sesamum, black gram and vegetables are the major crops grown in this zone.

3. Climate and Environmental situation

The state lies in the sub-tropical belt. The chief characteristics of the climate are high temperature and high rainfall. Three defined seasons prevail in the state. i.e. Hot dry Summer – March to May, Monsoon – June to October and Winter season – November to February.

4. Rainfall

The average annual rainfall of the state is 1500 mm with an average of 73 rainy days, out of which around 1386 mm rain received during monsoon season. i.e. June to October with average of 14 to 18 rainy days per month. The fluctuation in rainfall from year to year ranges from 600 to 800 mm in some districts. Drought, cyclone and flood are the usual calamities of the state. As the rainfall concentrated during Kharif season, the concentration of cropping is more during the season. The high co-efficient of variability in rainfall compels the farmers to bring the high lands under short duration rice or other low moisture requirement crops like millets, pulses, oilseeds, fiber crops or vegetables. The amount of rainfall during winter season is practically negligible.

5. Temperature

Temperature is one of the limiting factors in crop production. The mean temperature, the range of diurnal variation, diurnal change and temperature summation influence both the duration and growth patterns of the crops. The mean annual maximum temperature varies from 27⁰C in December to 42⁰C in May. In case of northern plateau and other interior areas, even maximum temperature goes up to 48⁰C. The lowest temperature is recorded during later part of December and early part of January. The mean minimum temperature during the period varies from 6⁰C to 9⁰C in interior regions and 12⁰C to 15⁰C in coastal areas. The diurnal variation of temperature for most of the interior areas of the state is high and ranges from 15⁰C to 20⁰C except in monsoon when the value of the same varies from 10⁰C to 15⁰C.

6. Humidity

The average annual relative humidity at 8 a.m. is 79%. Maximum humidity of 84% is recorded in August and minimum of 74% in May, the difference in annual range being only 10%. The central table land has the lowest humidity during March – May and is the driest part of the year. There is great variation in the humidity in different parts of the Ghat region. In Koraput district, the relative humidity ranges from 92% during monsoon to 60% during summer. The humidity in the coastal tract remains high throughout the year and never falls below 70% due to proximity of the sea.

The month wise average rainfall, number of rainy days, maximum and minimum temperature along with humidity is reflected in Table 2.

Table 2: Month wise climatic condition of Orissa (average of last fifty years)

Sl. No.	Month	Avg. Rainfall (mm)	No. of rainy days	Mean Temp. ($^{\circ}$ C)		Relative Humidity (%)
				Max.	Min.	
1	January	15.0	1.0	30	7	73.76
2	February	26.5	1.7	30	13	81.83
3	March	20.9	1.6	38	13	60.31
4	April	34.2	2.8	41	23	62.38
5	May	65.9	4.2	44	22	75.20
6	June	219.0	10.4	40	23	78.18
7	July	372.6	16.4	33	22	86.25
8	August	357.8	16.1	33	22	87.31
9	September	235.1	12.0	32	19	87.69
10	October	116.4	5.6	33	20	82.13
11	November	33.2	1.5	32	11	74.14
12	December	6.0	0.4	31	10	77.88
Annual average		1502.6	73.4	34.75	17.08	77.25

Source : Orissa Agricultural Statistics, 2000-01, Directorate of Agriculture, Orissa.
P. 1-2.

7. Evaporation

The rate of evaporation is an indicator of the vegetative possibilities of a given region. The rate of loss of water from plant surface exposed to the air is always lower than the rate of evaporation from an equal area of water surface under the same environmental condition. The total annual loss of water surface has been estimated to be 2142 mm or about 85 inches of water.

8. Sunshine

Light plays an important role in photosynthesis activities of plants. Performance of a crop variety is assessed by its capacity for minimum utilization of light energy. In Orissa, there are two distinct seasons of growing crops i.e. wet or kharif and dry or rabi season. Kharif season starts from June with nearly 13 hours of day length. Rabi season

starts from January with 10 hours day length and extended towards summer season up to May with dry length of day around 12 hours. The mean sunshine hours per day in Kharif ranges from 2.3 to 5.2 hours and in Rabi season 7.9 to 9.8 hours per day.

9. Soils of Orissa:

The soils of different agro-climatic zones of Orissa analysed under physiography. In general the residual soils of uplands are predominantly lateritic, highly leached, acidic (pH 5.0 ~ 6.50 and low in organic matter and nitrogen. The soil tends to be shallow, sandy and erodable in the uplands associated with low water holding capacity. The transplanted soils of the alluvial plains are moderately fertile, less acidic and generally more productive.

10. Water Wealth:

Orissa has enormous water wealth in its many rivers which are scattered all over the states. They cover an annual flow of 121 million ac-ft of water. Irrigation facilities have been expanded considerably since 1977. Over 20.81 lakh ha of land have been brought under irrigation through major, medium and minor irrigation projects including lift irrigation points. The crop wise irrigation potentialities in the state during the year 2000-2001 is presented in the following table which is self explanatory.

Table 3: Irrigated potentialities of the state (2000-2001)

Sl. No.	Crop	Irrigated area (000'ha)	% of crop area irrigated
1.	Kharif rice	1469.37	34.76
2	Summer rice	206.73	100.00
3	Wheat	15.95	100.00
4	Maize (Rabi)	5.22	87.00
5	Ragi (rabi)	2.93	72.70
6	Pulses (Rabi)	52.71	6.21
7	Oil seeds (Rabi)	43.76	13.55
8	Vegetables (Kharif)	68.72	42.03

Sl. No.	Crop	Irrigated area (000'ha)	% of crop area irrigated
9	Vegetables (Rabi)	140.99	73.17
10	Spices (Rabi)	35.07	58.24
11	Sugarcane	31.41	100.00
12	Tobaccos (Rabi)	1.07	31.66

Source: Orissa Agricultural Statistics 2000-2001; p-13

Though Orissa has a good source of water wealth, most of the interior districts are affected by drought regularly. Comparison of irrigated and un-irrigated area in different districts were also analysed and presented in the following table.

Table 4: Area under irrigation in different districts

Sl. No.	District	Cultivated area (000'ha)	Irrigated area (000'ha)	Un-irrigated area (000'ha)
1	Balasore	244.0	57.82	72.30
2	Bhadrakh	186.0	93.04	49.98
3	Bolangir	338.0	35.14	89.60
4	Sonpur	112.0	60.71	45.79
5	Cuttack	194.0	88.13	54.57
6	Jagatsinghpur	110.0	52.20	52.55
7	Jajpur	175.0	42.62	75.65
8	Kendrapara	152.0	63.66	58.12
9	Dhenkanal	217.0	39.94	51.59
10	Angul	226.0	35.34	84.36
11	Ganjam	398.0	224.72	45.54
12	Gajapati	80.0	23.15	71.16
13	Kalahandi	371.0	90.42	75.36
14	Nawapada	178.0	0.88	99.51
15	Keonjhar	302.0	15.72	94.79
16	Koraput	302.0	55.81	81.52
17	Malkangiri	141.0	26.88	71.94
18	Nawarangpur	215.0	11.59	94.61
19	Rayagada	203.0	38.46	81.05
20	Mayurbhanj	441.0	78.41	82.29

Sl. No.	District	Cultivated area (000'ha)	Irrigated area (000'ha)	Un-irrigated area (000'ha)
21	Kandhamal	134.0	13.91	89.62
22	Boudh	89.0	25.30	71.57
23	Puri	172.0	79.13	53.99
24	Khurda	137.0	48.92	64.29
25	Nayagarh	133.0	29.26	88.00
26	Sambalpur	194.0	68.87	64.50
27	Baragarh	345.0	122.20	64.58
28	Deogarh	72.0	16.71	76.79
29	Jharsuguda	85.0	12.40	85.41
30	Sundergad	313.0	51.01	83.70
31	Total	5829.0	1602.35	72.51

Source: Orissa Agricultural Statistics 2000-2001; p-10-14.

11. Cropping Intensity:

Orissa agriculture statistics 2000-2001 revealed that out of 15,571 thousand hectares geographical area, 7877.96 thousand hectares are cultivable lands out of which 5829thousand hectares i.e. 73.99% are net sown area. Rice, pulses, oilseeds, jute, mesta, sugarcane, spices and vegetables are important crops grown. The high, medium and low lands of the state constitute about 44.54%, 30.58%, 24.88% respectively. The cropping intensity of different districts of the state for 1999-2000 and 2000-2001 is presented below in Table 5.

Table 5: Cropping intensity of various districts in Orissa

Sl. No.	Districts	Cropping intensity (%)	
		1999-2000	2000-2001
1	Balasore	140	133
2	Bhadrakh	130	124
3	Bolangir	125	123
4	Sonpur	143	146
5	Cuttack	183	147

Sl. No.	Districts	Cropping intensity (%)	
		1999-2000	2000-2001
6	Jagatsinghpur	167	155
7	Jajpur	161	167
8	Kendrapara	166	159
9	Dhenkanal	145	125
10	Angul	138	132
11	Ganjam	164	153
12	Gajapati	145	154
13	Kalahandi	150	139
14	Nawapada	135	142
15	Keonjhar	131	133
16	Koraput	123	142
17	Malkangiri	148	123
18	Nawarangpur	129	136
19	Rayagada	133	131
20	Mayurbhanj	118	119
21	Kandhamal	119	130
22	Boudh	138	135
23	Puri	188	168
24	Khurda	157	143
25	Nayagarh	165	146
26	Sambalpur	131	121
27	Baragarh	129	124
28	Deogarh	134	112
29	Jharsuguda	122	119
30	Sundergad	120	114
31	Average	140	135

Source: Orissa Agricultural Statistics 2000-2001; p-10.

12. Land utilization pattern in Orissa:

The land utilization pattern speaks about much of the agricultural extension

planning in the state. Agriculture and land are not distinguishable separately. The total geographical area of the state remains the same 15572 thousand hectares. The development can be well judged from the type of land and its utilization for years together. The land utilization pattern for last 10 years has been depicted in the following table.

Table 6: Land utilization pattern in Orissa

Sl. No.	Year	Geographical area	Forest area	Misc tree	Permanent pasture	Culturable waste	Land put to non-agric. Use	Barren & unculturable land	Current fallow	Other fallow	Net area sown
1	1994-95	15571	5722	715	514	435	858	553	197	298	6279
2	1995-96	15571	5722	715	514	435	858	553	241	323	6210
3	1996-97	15571	5606	764	534	445	858	570	483	343	5968
4	1997-98	15571	5606	774	534	445	866	590	298	336	6122
5	1998-99	15571	5606	774	534	445	866	590	372	336	6048
6	1999-00	15571	5606	774	534	445	838	618	345	336	6075
7	2000-01	15571	5813	482	443	392	999	843	430	340	5829
8	2001-02	15571	5813	482	443	392	999	843	320	434	5845
9	2002-03	15571	5813	482	443	392	999	843	485	434	5680
10	2003-04	15571	5813	482	443	392	999	843	369	434	5796

Source: Economic survey 2004-2005, Government of Orissa

The above table reveals that the area under permanent pasture, miscellaneous trees, culturable waste are decreasing over years which can be inferred that land that were earlier being not in use are now used but may be due to lack of proper planning this land is not utilized for agriculture purpose rather there is a positive trend in forest area due to plantation programmes through several developmental schemes and departments. The tragedy is that much of the land is being put into non-agricultural use. Hopefully the agricultural use is not thought to be profitable and remunerative. It can also be said that due to lack of proper planning, valuation, vision and analysis of the future the land is not

appropriately utilized and becomes barren and uncultivable and simultaneously remain fallow for years, which shows a positive trend. The above situation as it reveals demand for a participatory and need based planning for the state.

13. Irrigation:

In the absence of adequate irrigation facilities, agriculture is pathetically dependent upon the monsoons. As a result of the erratic behaviour of the monsoon, agricultural production fluctuates widely from year to year. The net irrigation potential created by the end of 2003-04 from all sources was 2688.73 thousand hectares which is 45.57% of the total irrigable area of the state. Out of 25.43 lakh hectare of irrigated area, 1234.86 thousand hectares of land are irrigated through major and medium irrigation projects, 497.49 thousand hectares through minor (flow), 383.80 thousand through minor (lift) and 572.58 thousand through other sources which include private tanks, ponds, dug well, water harvesting structures and the like. However, assured irrigation available through major and medium irrigation projects accounts for 45.937% of the total area under irrigation. This underscores the need for stepping after assured irrigation potential in order to isolate agriculture from the vagaries of monsoon.

Table 7: Net irrigation potential in the state through different types of sources

(Area in 000' hectares)

Sl. No.	Irrigation source	Irrigated potential created upto end of				
		1999-2000	2000-01	2001-02	2002-03	2003-04
1	Major and medium	1,155.67	1,177.89	1,190.54	1,220.71	1,234.86
2	Minor (Flow)	441.35	450.37	455.63	471.16	497.49
3	Minor (Lift)	330.54	336.05	338.72	347.39	383.80
4	Other sources	557.72	557.92	557.92	570.47	572.58
	Total	2,485.28	2,522.23	2,542.81	2,609.73	2,688.73

Source: Economic survey 2004-2005, Government of Orissa p. 5/1

The table above clearly depicts a positive trend in net irrigation potential of the state that is a good sign for the agricultural scenario provided these resources are well planned and put to use most effectively. The crop and cropping pattern are to be well planned and need based as much as people oriented for better execution of the programmes for achieving desired end result.

14. Consumption of Fertilizer:

Fertiliser is one of the major production oriented inputs that decides the growth of agriculture in the state. As the above table shows there is an increase in the consumption rate but not appealing as in case of other states. The state ranks next to Kerala and Assam but is still much behind. May be it is due to low socio-economic status of the people in Orissa but the cause is to be identified and definite planning is to be made for tracing out the reason and scope for increasing the fertilizer consumption rate that decides the yield of the major crops.

Table 8: Position of Orissa in Consumption of fertilizer at all India level

(Kg/hectare)

Sl. No.	Name of the state	Consumption of fertilizer				
		1998-99	1999-2000	2000-01	2001-02	2002-03
1	Andhra Pradesh	147.37	155.50	159.84	143.47	128.44
2	Assam	18.93	27.94	35.68	38.81	42.73
3	Bihar	81.95	85.22	97.48	87.39	87.15
4	Gujarat	95.28	90.23	70.14	85.52	77.76
5	Haryana	132.66	142.69	147.20	155.69	152.79
6	Karnataka	93.31	103.30	109.52	101.48	90.91
7	Kerala	62.32	72.46	59.38	60.72	68.17
8	Madhya Pradesh	48.15	46.21	38.85	39.96	36.44
9	Maharashtra	74.99	87.13	74.35	78.24	73.80
10	Orissa	35.51	42.28	40.52	39.00	39.00

Sl. No.	Name of the state	Consumption of fertilizer				
		1998-99	1999-2000	2000-01	2001-02	2002-03
11	Punjab	169.43	184.22	166.69	173.38	174.99
12	Tamil Nadu	143.49	158.74	145.31	141.55	114.00
14	West Bengal	103.78	129.04	113.68	126.82	122.23
15	Rajasthan	33.98	42.37	31.06	38.88	28.54
	All India	87.08	93.81	86.34	90.12	84.82

Source: Economic survey 2004-2005, Government of Orissa p.4/15

15. Operational Holdings:

The agricultural census 1995-96 shows that there were 39.66 lakh operational holdings in the state in comparison to 38.84 lakh as per the 1990-91 census registering an increase of 2.11 % over a period of five years. The total area of the operational holdings which was 52.08 lakh hectare in 1990-91 has marginally declined to 51.44 lakh hectares in 1995-96. The average size of holdings which was 1.34 hectare in 1990-91 has decreased to 1.30 hectares in 1995-96.

Table 9: Status of operational holdings in the state

Sl. No.	Holding size	No. of operational holdings (in thousands)		Area of operation (in thousand heetares)	
		1990-91	1995-96	1990-91	1995-96
1	Marginal (Below 1.0 ha)	2081 (53.58)	2145 (54.08)	1027 (19.72)	1064 (20.68)
2	Small (1.0 ha to 2.0 ha)	1021 (26.29)	1106 (27.89)	1406 (27.00)	1522 (29.59)
3	Semi-medium (2.0 ha to 4.0 ha)	585 (15.06)	544 (13.72)	1539 (29.55)	1451 (28.21)
4	Medium (4.0 ha to 10.0 ha)	182 (4.68)	156 (3.93)	994 (19.09)	864 (16.80)
5	Large (10.0 ha and above)	15 (0.39)	15 (0.38)	242 (4.64)	243 (4.72)
	Total	3884 (100.00)	3966 (100.00)	5208 (100.00)	5144 (100.00)

Figures in brackets indicate percentage to total

Source: Economic survey 2004-2005, Government of Orissa p.4/23

16. **Livestock population:**

Development of animal resource has considerable relevance and significance for development of an agrarian economy. Next to crop production animal husbandry is the most important income generating activity in rural house holds. The distribution of livestock population in the state as per Livestock census 2001 is given below.

Table 10: Livestock population in Orissa

Census year	Cattle		Buffaloes	Goats	Sheep	Pigs	Total
	Total	Crossbred					
1995	147.66	7.44	16.52	54.12	18.65	5.72	242.67
2001	138.10	8.70	13.88	58.80	17.79	6.02	234.59

Source: Economic survey 2004-2005, Government of Orissa p. 7/14

It is observed that the percentage of cross breed/ improved animals in our state is very poor that is out of total cattle population the percentage of cross bred cattle is 6.3% and in case of buffalo the percentage of improved buffalo is 2.3% only.

17. **Availability of animal products:**

The per capita availability of animal products has by and large gone up steadily. The per capita availability of milk has exceeded the Ninth plan target of 66g/head/day while that of egg is lagging behind the target of 32 eggs/head/ annum during 2003-04. The production of milk and egg was 84.6 million tones and 34,034 million numbers at all India level and in our state it was only 0.93 million tones and 858.02 million numbers respectively during 2001-02. However, the state agricultural policy 1996 aims at increasing the production and productivity in dairy, poultry and encourage other animal husbandry activities through scientific breeding, balanced feeding, adequate health care, better marketing facilities and improved management practices.

Table 11: Year wise production and per capita availability of milk, meat and eggs in Orissa

Year	Production of milk (Thousand MT)	Per capita availability of milk (g/day)	Production of meat (Thousand MT)	Per capita availability of meat (kg/annum)	Production of eggs (Millions)	Per capita availability of eggs (Nos./annum)
2000-01	875.00	67	38.38	1.067	730.30	20
2001-02	929.00	70	42.64	1.176	858.02	24
2002-03	941.00	71	44.72	1.224	909.49	25
2003-04	995.00	74	44.89	1.218	931.06	25

Source: Economic survey 2004-2005, Government of Orissa p.7/15

18. Fisheries Resources:

Fishery, an allied sector of agriculture is gradually drawing attention as an important area for employment and income generation. Orissa being abundant with water resources has enough scope and potentialities for development of fisheries sector. The state is one of the important maritime states of India having excellent scope of potentialities for development of fisheries sector. It has a coastline of 480 kms with continental shelf area of 24,000sq. kms along the Bay of Bengal. It is also endowed with brackish water area of 4.18 lakh hectares and fresh water area of 6.66 lakh hectares. Orissa ranks 7th in total production of fish amounting to 306.95 thousand MT contributing to 4.79% of total production of the country (6399.44 thousand MT) .

Table 12: Total Production of fish in Orissa

(in Thousand MT)

Sl. No.	Year	Inland fish production			Marine fish production	Total Production	Per capita fish consumption (kg)
		Fresh water	Brackish water	Total			
1	2001-02	147.40	20.66	168.06	113.89	281.95	8.14
2	2002-03	154.42	19.96	174.38	115.01	289.39	8.28
3	2003-04	165.59	24.48	190.07	116.88	306.95	8.28

Source: Economic survey 2004-2005, Government of Orissa p.7/3

19. Forest:

Forests play a vital role in maintaining ecological stability. They provide protection against, and reduce impact of, natural calamities like droughts, floods, cyclones. Forests are an important source of livelihood for weaker sections of society in general and tribal in particular. Forests also provide a wide variety of products of commercial value such as timber, lac, resins, oilseeds, kendu leaves and medicinal plants.

Orissa has a record of forest area measuring 58,136.23 sq. km including 26,329.12 sq. km of reserve forest, 11,686.44 sq. km of demarcated and protected forests, 3838.78 sq. km of undemarcated protected forest, 20.55 sq. km of un-classified forest and 16261.34 sq. km of other forests including village and private forests which is 37.34% of the state's geographical area of 1,55,707 sq. km. As per the 'State of Forest Report - 2001' prepared by the 'Forest Survey of India', the state has only 48,838 sq. km of forest cover including 219 sq. km of mangrove forests and 5782 sq. km of scrub.

Forests of the state are unevenly distributed. The coastal districts with higher population density are having smaller areas of forest. Higher forest coverage is found in the districts of Kandhamala, Sundergarh, Mayurbhanja, Sambalpur, Malkangiri, Gajapati, Deogarh and Keonjhar. The National Forest Policy 1988 has mandated that 33% of the geographical area should be under forest cover, with 60% cover in hilly tracks and 20% in plains. Against this the state has 31.4% forest cover according to Forest Survey of India. Thus there is an imperative need to accelerate efforts of afforestation and regeneration of the degraded forests for achieving the mandated 33% forest cover. (Source: Economic survey 2004-2005, Government of Orissa p. 6/1)

Chapter - IV

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

This chapter deals with methods and procedures used in the study. The chapter contains three parts. The first part deals with the sampling technique and the second part covers the empirical measures of different variables and last part describes details of data collection and statistical measures used in the study.

1. Sampling technique:

1.1. Selection of districts:

The study is designed to investigate the sustainability of agriculture in the coastal tract of Orissa. The major concern of sustainability is observed in coastal tract of Orissa as the problem of salinity, flood, depletion of ground water etc are observed more than other parts of the state. Any attempt to work towards sustainability in agriculture has to look into land status of the state. Orissa has land problems in respect to salinity, low land, water merged and different types resulting in low level of productivity.

Table 13: District wise distribution of coastal saline lands in Orissa with present land use

Sl. No.	District	Land use (Area in ha.)			
		Agriculture	Mangrove	Idle	Total
1	Ganjam	6,480	--	3,465	9,94
2	Puri	43,930	3,250	13,076	60,256
3	Cuttack	67,342	18,667	9,440	95,449
4	Balasore	75,679	3,249	10,543	89,471
	Total	1,93,431	25,166	36,524	2,55,121

Again water logging is a problem in coastal districts. The waterlogged area is posed to be highest in the district of Cuttack followed by Puri, Balasore and Ganjam.

Table 14: Analysis of water logging in the coastal districts

Area in '000 ha

Sl. No.	Name of the district	Area Sown (net)	Irrigated area	% of area under irrigation in composition to net area sown	Total land waterlogged	% of Water logged area in relation to irrigated area
1	Cuttack	705	242	34.32	21.36	8.82
2	Puri	466	169	36.26	13.95	8.25
3	Balasore	424	71	16.74	6.36	8.95
4	Ganjam	501	226	45.10	5.86	2.58

Keeping these considerations in view four districts namely Puri, Khurda, Ganjam and Balasore were selected after careful considerations. Districts were selected considering seriousness of land problem, water logging, salinity and frequent occurrence of natural calamities. (Super Cyclone 1999)

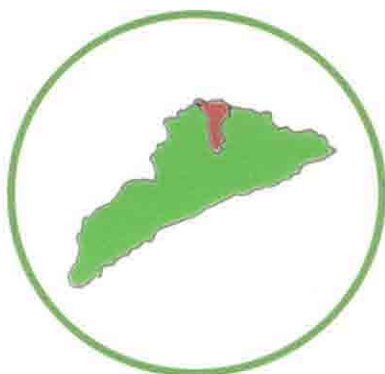
1.2. Selection of Blocks:

Selection of block was done purposively. From each district, one block was selected to carry out the study. The blocks covered under study were, Pipili of Puri district, Balipatna of Khurda district, Hinjilicut of Ganjam district and Basta of Balasore district.

1.3. Selection of villages:

Two representative villages from each block were selected. The selection of villages was based on considerations like, (a) magnitude of problem, (b) Co-operation of people, (c) Scope for improvement in ecology, (d) Medium productivity level of crops and (e) No such studies carried out earlier.

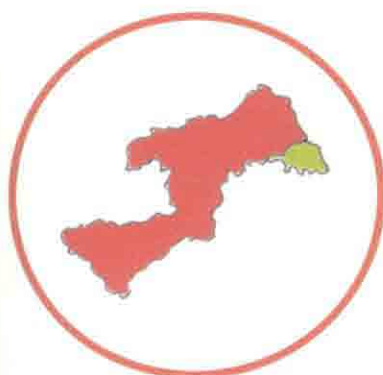
Figure – 1 : Map showing area of the study



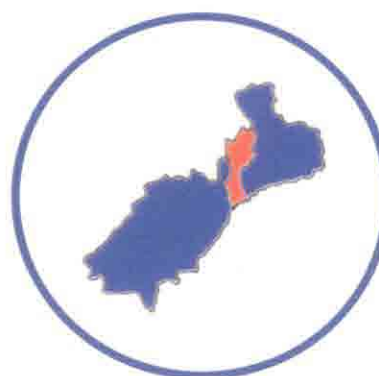
District: Puri
Block : Pipili
Village: 1. Aruha
2. Bantalsingh



District: Ganjam
Block : Hinjili
Village: 1. Sampur
2. Makarjhol



District: Khurda
Block : Balipatna
Village: 1. Alasi
2. Rajasa



District: Balasore
Block : Basta
Village: 1. Sadanandapur
2. Baunsamukha

Table 15: Villages, Blocks and Districts under study

District	Block	Village
Puri	Pipili	Aruha
		Bantalsingh
Khurda	Balipatna	Alasi
		Rajasa
Ganjam	Hinjilicut	Sampur
		Makarjholā
Balasore	Basta	Sadanandapur
		Baunsamukha

1.4. Selection of respondents:

The study considered only small and marginal farm operators as per definition of State Govt. of Orissa. From the list available at block level, a total of 200 respondents at the rate of 25 from each village were finally selected for interview and data collection given in Table 16 in the following page. The study encompasses 200 numbers of respondents selected randomly at the rate of 25 from each village covering 8 villages of 4 blocks of 4 districts.

Table 16. Basic facts about the villages under investigation (2004-05)

Sl. No.	Facts	Pipili Block		Balipatna Block		Hinjili Block		Basta Block	
		Aruha	Bantal singh	Alasi	Rajasa	Sampur	Makara jhola	Sadanan dapur	Baunsa mukha
1	Geographical area (ha)	143.2	195.0	126.0	498.4	216.0	516.0	184.6	87.2
2	Cultivable area (ha)	130.0	183.4	106.0	467.0	210.0	464.0	170.0	69.0
3	Cultivated land (ha)	124.0	180.0	106.0	467.0	210.0	464.0	170.0	69.0
4	High land (ha)	28.0	30.0	9.0	10.0	43.0	72.0	10.0	10.0
5	Medium land (ha)	80.0	80.0	34.0	200.0	95.0	145.0	98.0	21.0
6	Low land (ha)	16.0	70.0	63.0	257.0	72.0	246.0	62.0	38.0
7	Irrigated land (ha)								
	(i) Kharif	103.0	168.0	85.0	102.0	189.0	423.0	100.0	40.0
	(ii) Rabi	70.0	47.0	42.0	60.0	20.0	40.0	78.0	21.0
8	Total no. of families	186	251	83	156	297	726	222	261
9	Total no. of farm families	158	216	58	119	246	534	187	196
10	Marginal farm families	77	116	28	56	150	258	100	142
11	Small farm families	45	48	22	38	51	250	55	32
12	Medium farm families	21	34	--	--	--	--	22	6
13	Large farm families	15	18	8	25	45	26	10	16
14	Landless Labour	28	35	25	36	51	192	35	65
15	Respondents selected	25	25	25	25	25	25	25	25
16	Percentage sample to farm families	6.32	8.64	43.10	21.00	10.16	4.68	13.37	12.80

1.5. Selection of variables:

Independent variables included in the study were selected on the basis of review of literature, discussion with the experts, judges rating method and preliminary study conducted in the area of investigation. Only those variables, which were found having relevance with sustainability of agriculture were included within the framework of the study. The variables and their measurements covered under the study as are has been included interview schedule (Appendix - I).

The variables grouped under independent factors and their relationship with dependent variables on sustainability of agriculture were invariably studied in all the aspects. As per interview schedule, the variables have been arranged under three parts namely personal, social, economic, communication, marketing behaviour, farming behaviour and training.

The second part of the interview schedule contains perception about sustainability of agriculture in terms of ecological soundness, economic viability, social accessibility, humaneness and adaptability.

The third part of the schedule deals with adoption in sustainability measures, extension components and suggestions.

The scoring of different variable was made as described below.

The schedule meant for experts consisted of two parts. The first part dealt with factors of sustainability of agriculture and the second part was used to obtain suggestions to attain sustainability of agriculture. (Appendix II)

1.6 Techniques used for collection of Data:

a. Preparation of interview schedule:

As per the objectives set for the study, two sets of interview schedule were prepared, one for the farmers respondents and the other for the experts. The schedule contained both open and close ended questions.

The schedule meant for the respondents consisted of five parts. The first part was concerned with socio-economic and farming related variables and the second part included the information on factors of sustainability of agriculture as perceived by the respondents. The third part was designed to determine the relative position of sub-factors and adoption of recommended measures of sustainability of agriculture. The fourth part has dealt with extension and communication elements that are required to maintain sustainability of agriculture as per the opinion of the respondents. The last part of interview schedule was designed to obtain suggestions for preservation and maintenance of sustainability of agriculture.

b. Pre-testing of the schedule:

Pre-testing of the schedule was made to find out its applicability to record the data. After development of the schedule, it was pre-tested with twenty five numbers of farmers of Ganjam and Puri districts at random. On the basis of observations made during the testing, necessary modifications and refinements were accommodated in the schedule.

c. Collection of information:

Collection of information is the field work for collecting qualitative and reliable information as per schedule. Personal contact was made by the investigator in interviewing the respondents selected for the investigation. The respondents were contacted in person at their residence. Good rapport was established with desirable

climate setting, which helped to ask questions and discuss various issues relating to the studies. The purpose of the study was clearly apprised to the respondents before asking questions. Each aspect of the schedule was also clearly appraised to obtain unbiased response. The information received were duly recorded for analysis. The data were collected during the year 2003 and 2004. The schedule was read out in local language i.e. Oriya to the respondents. The assistance of local VAWs, AEOs, University extension personnel and local key communicators was availed in interviewing the farmers.

Apart from data collected from the respondents, information from secondary sources like Govt. publications, international publications, research papers, annual reports, papers presented in national and international seminars and other published documents were also made use for the study.

2. Empirical Measurements of variables

Variables used in the study were quantified depending on their relative merit in qualifying the measurements. Scoring method was adopted to measure the variables as has been detailed below.

2.1. Personal variables

i. Age:

It is the chronological age of the respondents in completed years at the time of investigation. The scores assigned to age groups were as follows.

Age	Score assigned
Upto 30 years	1
31 to 40 years	2
41 to 50 years	3
Above 50 years	4

ii. Education:

For assessing educational status of farmers, the number of years of formal education attended by the respondents were taken into account. The scoring system followed in socio-economic status scale was developed for the study to quantify the educational status. The scoring made is as follows.

Education	Score assigned
Illiterate	0
Primary	1
M.E. School	2
High School	3
College	4

2.2. Social Variables

i. Family composition:

Family composition was operationalised on the basis of number of members in the family. The score assigned is as follows.

Family composition	Score assigned
Upto 4 members	1
More than 4 members	2

ii. Family type:

Family type was operationalised on the basis of whether the members were jointly staying with a common kitchen or not. The score assigned is as follows.

Family type	Score assigned
Nucleus family	1
Joint family	2

iii. Caste:

The term caste has been conceived as the endogamy, exclusive and functional group to which the individual belongs. The scores assigned to caste for the beneficiaries are as follows.

Caste	Score assigned
ST	1
SC	2
OBC	3
Others	4

iv. Membership in formal organization:

The score was assigned on the basis of membership of the respondents in different organizations working for the rural development is as follows.

Membership in formal organisation	Score assigned
No membership	0
Membership in one organization	1
Membership in 2-4 organizations	2
Membership in >4 organizations	3

2.3. Economic variable:

i. Land holding:

On the basis of size of operational holdings of the sample respondents the scores assigned is as follows.

Land holdings	Score assigned
Upto 1 ac (0.4 ha)	1
1.1 to 2.0 ac (0.44 -0.8 ha)	2
2.1 to 3.0 ac (0.84 -1.2 ha)	3
3.1 to 4.0 ac (1.24 - 1.6 ha)	4
4.1 to 5.0 ac (1.8 - 2.0 ha)	5

ii. Occupation:

Occupational status refers in the study are farming and other sources from where income is received by the households .

iii. Irrigation:

The scoring pattern used for existence of irrigation facility for the sample respondents is as follows.

Irrigation	Score assigned
No irrigation facility	1
Irrigation facility exists	2

iv. Crops grown:

The scoring pattern was developed on the basis of number of crops grown by the respondents in a year is given below.

Crops grown	Score assigned
Mono crop	1
Two different crops	2
Three different crops	3

v. Live stock:

The score assigned for the live stock possession for the study is as follows.

Live stock	Score assigned
Upto 4 animals	1
> 4 animals	2

vi. Additional source of income:

It refers to the allied agricultural enterprises like livestock and fishery as additional source of income along with main occupation. The scores assigned is given - below.

Additional source of income	Score assigned
Only live stock	1
Live stock + Fishery	2

vii. Use of energy in farming:

Energy is an essential critical input for better profit in farming. In this study, use of energy by the farmer for farming practice has been categorized as whether the energy is used or not used. The score assigned is as follows.

Use of energy in farming	Score assigned
Used	2
Not used	1

viii. Use of farm implements:

Mechanisation in farming is gaining momentum in the state. In the study, the use of farm implements by the farmers has been studied and the score assigned is given below.

Use of farm implements	Score assigned
Upto 4 implements	1
>4 implements	2

2.4. Communication behaviour:

Communication behaviour of a person indicates his information seeking

attributes. In the study the communication behaviour refers to Exposure of respondents to newspapers, radio and television. The scoring pattern developed is given below.

Exposure to mass media	Score assigned
Exposed	1
Not exposed	0

2.5. Marketing behaviour:

Market linkage is an essential ingredient for profitable farming. The marketing behaviour of the farmers refers to place of marketing, opinion about the sale price and marketable surplus. The score assigned is as follows.

i. Place of marketing

Place of marketing	Score assigned
Own locality	1
Outside locality	2
Outside district	3

ii. Opinion about sale price

Opinion about sale price	Score assigned
Quite remunerative	4
Remunerative at times	3
Not remunerative	2
Less concern	1

iii. Marketable surplus:

Marketable farm produce	Score assigned
Just manageable	1
Little over family maintenance	2
Much more than family requirement	3
Only grow for market	4

2. 6. Farming behaviour:

Experience of a person enables him to take more responsibility in new enterprise. Experience of the farmer in completed years and their responsibility have been referred in the study in the following way. The scores assigned is as follows.

i. Experience in farming

Experience in farming	Score assigned
Upto 20 years	1
More than 20 years	2

ii. Farming responsibility

Farming responsibility	Score assigned
Only supervisory work	1
Supervision and management	2
Direct work in the field	3
Supervision, management and field work	4

2.7. Training:

Training brings positive change in knowledge, skill and attitude of a person. In this study, training refers to training received by the farmers and use of knowledge gained through training. The scores assigned are given below.

i. Training undergone

Training undergone	Score assigned
Yes	1
No	2

ii. Use of knowledge gained through training

Use of knowledge gained through training	Score assigned
Yes	1
No	2

3. Perception on sustain ability of agriculture:

The ranking of factors of sustainability of agriculture was calculated by assigning 5 marks to first position and 1 to last position. Accordingly the score pointed availed by individual was assessed.

3.1. Ecological soundness: Perception about ecological soundness was studied in a 5 point scale with assigned score to the statements as follows

Strongly agree	-	5
Agree	-	4
Undecided	-	3
Disagree	-	2
Strongly disagree	-	1

Altogether six statements were included to qualify the ecological soundness.

3.2. Economic viability: Similar scoring pattern was followed assigning scores:

Strongly agree	-	5
Agree	-	4
Undecided	-	3
Disagree	-	2
Strongly disagree	-	1

Altogether six statements were included to qualify the economic viability.

3.3. Social accessibility: Similar scoring pattern was followed assigning scores:

Strongly agree	-	5
Agree	-	4
Undecided	-	3
Disagree	-	2
Strongly disagree	-	1

Altogether six statements were included to qualify the Social accessibility.

3.4. Humaneness: Similar scoring pattern was followed assigning scores:

Strongly agree	-	5
Agree	-	4
Undecided	-	3
Disagree	-	2
Strongly disagree	-	1

Altogether six statements were included to qualify the humaneness.

3.5. Adaptability: Similar scoring pattern was followed assigning scores:

Strongly agree	-	5
Agree	-	4
Undecided	-	3
Disagree	-	2
Strongly disagree	-	1

Altogether six statements were included to qualify the adaptability.

Further Ecological soundness was studied assigning rank to ingredients perceived as very important, important and some what important with assigned scores of 3,2,1 respectively. Similarly, economic viability, social accessibility, humaneness and adaptability were studied assigning rank to ingredients perceived as very important, important and some what important with assigning score 3, 2, 1 respectively.

3.6. Sustainable Agriculture Index (SAI) :

SAI has been worked out on the basis of 5 important parameters i.e. ecological soundness, economic viability, social accessibility, humaneness and adaptability and taking their relative position with assigned score and making it average.

$$SAI = \frac{\text{Scores obtained} \times 100}{\text{Total No. of statements with Maximum Obtainable Score}}$$

3.7. Adoption of recommended measures of sustainable agriculture:

This has been studied in reference to whether farmers adopt or do not adopt the recommended measures of sustainable agriculture. Score assigned is 1 for adopted and 0 *for not adopted.*

3.8. Ranking of Sub-factors of sustainability of Agriculture :

The sub-factors of sustainability of agriculture were ranked through assigning scores 3, 2 and 1 to very important, important and less important respectively.

3.9. Extension approaches:

The suggestive extension measures to enhance sustainability in agriculture was studied under components of social structure, cooperation mechanism, evaluation technique and marketing network. The sub-components under each component was highlighted in order of importance through ranking.

3.10. Suggestions:

Suggestions of the respondents as well as experts were recorded under the components of ecological soundness, economic viability, social" accessibility, humaneness and adaptability. An exhaustive list has been prepared and placed in the study.

4. Statistical methods used:

The following statistical methods were used in the study for analysis of responses based on the nature of the data and type of information required.

i. Percentage:

Percentage was used in descriptive analysis for making comparisons. To calculate the percentage, the frequencies in the particular cell was multiplied by 100 and divided by the total number of respondents in that particular category.

ii. Mean score:

It is also another simple comparison, which is calculated by using the formula

$$M.S. = \frac{\sum fx}{N}$$

Where,

$\sum fx$ = Total score obtained in individual category

N = Total number of respondents

iii. Rank order analysis:

On the basis of average mean score, the rank order was made. The item scoring highest mean score was given first rank and the next highest with second rank and so on.

iv. Pearson's coefficient of Correlation:

It was employed to find out the association of the dependent variables with the independent variable. It was also used to observe relationship of the independent as well as dependent variables themselves. Pearson's coefficient correlation was used to find out zero order correlation between dependent and independent variables to see the degree of closeness of linear relationship. The formula used for calculating coefficient of correlation is as follows.

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{[N \sum x^2 - (\sum x)^2] \times [N \sum y^2 - (\sum y)^2]}}$$

Where,

N = Number of pairs correlated

x and y = The variables being correlated

$\sum$ = Summation of overall entries of variables

r = Correlation coefficient between x and y

v. Student's 't' test:

The test was applied in this study to test the significance of difference between means of any two categories of respondents. The formula used for calculating 't' value was as follows:

$$t = \frac{\text{Difference between means}}{\text{Standard error of difference}}$$

The significance of 't' was tested by referring to 't' table. If the observed value of 't' was equal to or greater than table value of 't' at $(n_1 + n_2 - 2)$ degree of freedom under 0.05 level of probability, it was considered significant.

vi. Gap analysis:

The gap analysis was worked out by finding out difference between Maximum Obtainable Score and actual score obtained and expressed in terms of percentage following the formula:

$$\text{Gap\%} = \frac{E - A}{E}$$

Where,

E = Maximum Obtainable Score

A = Actual score obtained

vii. Analysis of variance (ANOVA)

Analysis of variance was applied to find out the difference between factors of sustainability of agriculture and the districts under study. The formula applied was as per one-way analysis of variance and ANOVA table was formed. The variance ratio (F) was tested with respect to the tabular value to find out any significant difference between them.

viii. Critical Ratio Test (C.R. Test):

This test was applied to test the significant difference between two percentages. Critical ratio was found out by dividing the difference between the percentages of two samples by its standard error ($CR = D/\sigma P$). To find out CR value the formula used was:

$$CR = \frac{(P_1 - P_2) - 0}{\sigma (P_1 - P_2)}$$

$$\sigma D \% = \sigma (P_1 - P_2) = \sqrt{\sigma (2P_1 + 2P_2)} = \sqrt{PQ (1/N_1 + 1/N_2)}$$

$$P = \frac{N_1 P_1 + N_2 P_2}{N_1 + N_2}$$

$$Q = 1 - P$$

Where,

N_1 = Size of first sample

N_2 = Size of second sample

P_1 = Per cent of first sample

P_2 = Per cent of second sample

σ = Standard error of difference of two percentages

The significance of 'CR' was tested as in case of 't' test referring to 't' table. If the observed value of 'CR' was equal to or greater than the table value of 't' at $(n_1 + n_2 - 2)$ degrees of freedom under 0.05 level of probability, it was considered significant.

ix. Duncan's multiple range test

Duncan Multiple Range Test was used in the present study to find out whether the two means being compared are adjacent, or whether one or more other means fall between those being compared. Thus, it was determined to know whether two means of socio-economic and farming related variables are significantly different from others with respect to different perception level. The computational formula for the Duncan's Multiple Range Test is as follows.

$$C_{diffs} = K_r \sqrt{\frac{MS_{within\ group\ error}}{N_{(per\ group)}}}$$

Where,

The several K values are obtained from the table of Duncan's Multiple Range Test.

x. χ^2 test

The Chi-square test was conducted to compare the effects of socio-economic and farming related variables and perception of the respondents as per the formula given below:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where,

O = Observed value

E = Expected value

The significance of calculated χ^2 value was tested with the tabulated value of χ^2 at $(n_1 - 1) \times (n_2 - 1)$ degree of freedom under 0.05 level of probability. If the calculated value was equal to or greater than the tabulated value of X^2 , it was considered significant.

xi. Multiple correlation

Multiple correlation co-efficient 'R' was evaluated to determine the relationship of one factor of sustainability agriculture with the remaining factors and square of multiple correlation coefficient (R^2). The R^2 represents the proportion of total variation explained by the independent variables. The findings are represented in terms of percent variation and the multiple R^2 multiplied by 100 can be interpreted as the % of total variation explained by the relationship worked out.

xii. Factorial 'r' matrix

Each independent variable was correlated with other independent variables to give the 'r' - matrix which represent the relationship existing among the variables.

xiii. Spearman rank order correlation (rho)

Spearman's 'rho' (ρ) was used to determine whether two sets of rank ordered data i.e. of respondents and experts towards the sub-factors of sustainability of agriculture are significant or not. The formula used for computing ' ρ ' is as follows:

$$\text{'rho' } (\rho) = 1 - \frac{6 \sum D^2}{N (N^2 - 1)}$$

Where,

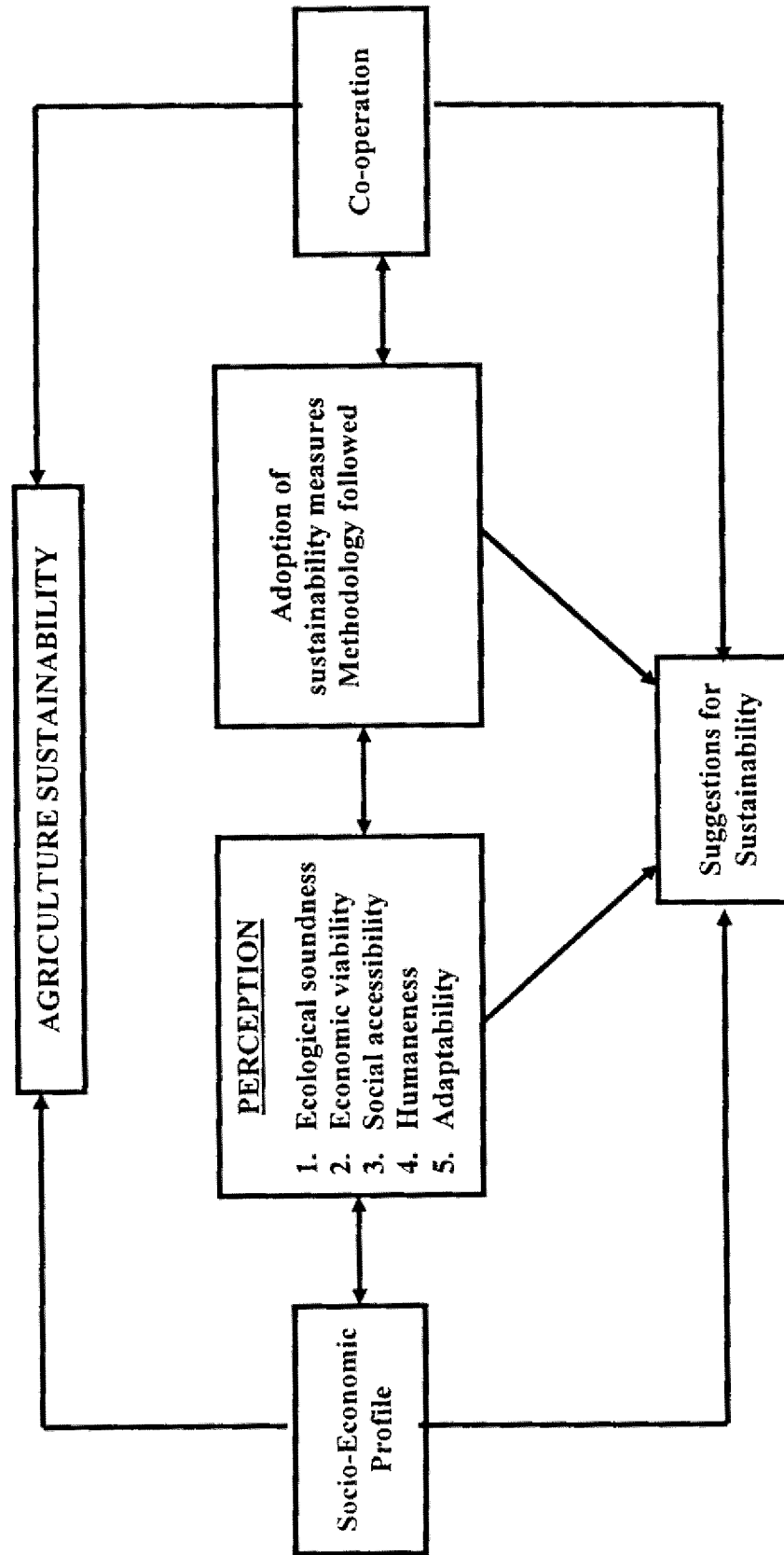
D = Difference score between two pairs

N = Number of pairs of scores

Test significance of 'p' was evaluated computing 't' test as per following formula and referring to "t" table. If the calculated value of 't' was equal to or greater than the table value of 't' at (n-2) degree of freedom under 0.05 level of probability, it was considered significant.

$$t = \rho \sqrt{\frac{N-2}{1 - \rho^2}}$$

Figure 2: Conceptual framework of the study



Chapter - V

FINDINGS AND DISCUSSION

FINDINGS AND DISCUSSION

The study entitled “Factors affecting sustainability in agriculture in small farm production system in coastal ecosystem of Orissa” was conceived out of considerations that the natural resources are not consumed scientifically resulting in stagnation of productivity. The study so designed was carried out in four districts of the state covering four blocks and eight villages with 200 respondents. The sustainability of agriculture requires more attention for actualizing concept at micro level. The farmers of all agro climatic zones needs to be sensitized to understand and make effort to conserve natural resources like soil, water, air, topography, forestry etc. The present study has attempted to investigate into various aspects of factors that affect sustainability in agriculture at small farm production system in coastal ecosystem of Orissa. According to an estimate the coastal ecosystem is at threat to sustain vegetation as used to be grown in the zones. To sustain ecosystem community participation play a vital role. The rural community of coastal belts of Orissa consists of small & marginal farmers whose land holdings are on an average up to 1 ha. to 2 ha. Since the majority are small farmers it was assumed that unless and otherwise they are sensitized to the devastating effects of mismanagement of natural resources, they may not have interest to work in these direction. The study has attempted to explore the relationship between perception about the sustainability in agriculture, socio-economic factors, experience in farming and knowledge source through which the farmers receive information. The socioeconomic variables under study consists of 14 selected variables namely; age, education, caste, family type, membership in formal organization, family composition, major occupation, land holdings, crops grown, irrigation, farm machinery, animal wealth, livestock and fishery and energy use. The variables are quantified through application of suitable scales as have been reflected in the following descriptions.

OBJECTIVE - I

SOCIO-ECONOMIC AND FARMING RELATED VARIABLES

Social research concentrates more on socio economic variables to find out effects of the events that take place in social system. The magnitude of variation among the variables assumes to bring variation on the effect. The present study attempted to examine as many variables as possible relating to farming system of the coastal ecosystem. The variables so identified, are personal, social, economic, communication behaviour, marketing behaviour, farming behaviour and training. The sub variables under the headings were identified as given in Table 1.

Table 17 : Profile of sample under study

Sl. No.	Major variables	Sub-variables
1	Personal	1. Age 2. Education
2.	Social	1. Family composition 2. Family type 3. Caste 4. Membership in formal organization
3.	Economic	1. Land holding 2. Occupation 3. Irrigation 4. Crops grown 5. Livestock 6. Additional source of income 7. Use of energy 8. Farm implements

Sl. No.	Major variables	Sub-variables
4.	Communication behaviour	1. Newspaper 2. Radio 3. Television
5.	Marketing behaviour	1. Marketable produce 2. Opinion about sale price 3. Place of marketing
6.	Farming behaviour	1. Experience in farming 2. Farming responsibilities
7.	Training	1. Training received 2. Use of training knowledge

Summarizing the major factors and sub factors, the total independent variables under study are as follows:

Table 18 : Independent variables of sample profile

Sl. No.	Independent variables	Number of Sub-variables
1	Personal	2
2.	Social	4
3.	Economic	8
4.	Communication behaviour	3
5.	Marketing behaviour	3
6.	Farming behaviour	2
7.	Training	2
	Total	24

Further, as per the requirement of the study the profile of the sample was examined in connection with the different perception levels about the sustainability of

agriculture. It is so because all the variables identified mainly, personal, social, economic, communication behaviour, marketing behaviour, farming behaviour and training have direct bearing on the formation of perception about any event particularly sustainability in agriculture in which they reside and work.

1.1. LEVEL OF PERCEPTION:

The level of perception was decided taking difference between maximum and minimum score obtained by the sample. As much as 21% of the differential score constituted the low perception of sample, where as more than 54% high level and leaving the rest in between, under medium level. The analysis so obtained is classified in the following table.

Table 19 : Classification of sample based on level of perception(n=200)

Level of perception	Score range	Frequency	%
Low	Up to 94	42	21
Medium	95 to 106	108	54
High	107 and more	50	25

The classification of sample on the basis of score obtained against core items of sustainability like ecological soundness, economic viability, social accessibility, humaneness and adaptability were taken into considerations assigning score on a five point scale. The relationship between profile of sample and level of perception has been explored to analyze data as follows.

1.2. PERSONAL FACTORS

i. Age group

Many of the extension studies reported that with increase of the age the knowledge and adoption level increases resulting in perceptiveness of the individual. While examining the hypothesis, the study made classification of sample into four different groups and explored the relationship with the level of perception about sustainability of agriculture.

Table 20: Age and perception on sustainability about agriculture (n=200)

Sl. No	Age group	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Up to 30	0	0	0	0	0	0	0	0	13.505 *
2	31 to 40	1	2.44	4	3.70	2	4.00	7	3.50	
3	41 to 50	17	40.50	63	58.33	38	76.00	118	59.00	
4	51 and above	24	57.14	41	37.97	10	20.00	75	37.50	
5	Total	42	100.00	108	100.00	50	100.00	200	100.00	

* Significant at 5% level of probability

The findings contained in the table above revealed that a high level of perception is found with the age group of 41 to 50 years while the respondents below 30 years and above 51 years had decreasing level. The Chi- square value being significant confirms that sample of higher age group have better understanding of sustainability owing to their experience, working in agriculture and exposure to farming world.

ii. Educational status:

Almost all sociological studies try to explore the impact of education on various aspects of human development. Education is one of the most important factors to bring people to the world of progressiveness. The present study attempted to ascertain

influence of educational status on perception level. The respondents have been classified according to five levels of formal education starting from illiteracy to college level.

Table 21: Education with perception on sustainability of agriculture (n=200)

Sl. No	Education	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Illiterate	9	21.43	1	0.93	1	2.00	11	5.50	43.32*
2	Primary	8	19.05	42	38.89	9	18.0	59	29.50	
3	M.E. School	18	42.86	39	36.11	18	36.0	75	37.50	
4	High school	7	16.67	17	15.74	12	24.0	36	18.00	
5	College	0	0	9	8.33	10	20.0	19	9.50	
6.	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

A glance at the table reveals that highest percentages of respondents (37.5%) were educated up to M.E. School level followed by primary level to an extent of 29.5%. The respondents at high school level were observed to be 18% followed by 9.5% at college level. However, the percentage of illiterates was minimum (5.5%). Comparing three groups of respondents in the matter of perception level, higher trend in position was observed with rise of educational level. The χ^2 test being significant confirmed that perception is closely associated with level of education.

1.3. SOCIAL FACTORS :

The social factors included in the study consisted of family composition, type of family, caste and membership in formal organization.

i. Family composition:

The concept of small family has been accepted by majority of our population permitting reduction in family size. According to sociological studies composition of family and cohesiveness in interaction have direct influence on progressiveness and

attitude of individuals leading to positive perception. While examining family composition of sample under study, in group of up to 4 and above 5 members per family, the following results were obtained.

Table 22: Composition of family and perception of sustainability in agriculture (n=200)

Sl. No	Family composition	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Up to 4	8	19.05	12	11.11	7	14.0	27	13.50	1.645 N.S.
2	More than 5	34	80.95	96	88.89	43	86.0	173	86.50	
3	Total	42	100	108	100	50	100	200	100	

The analysis of table reveals that 86.5% of the samples have the family with 5 members on an average while 13.5% who have upto 4 members per family. Similar trend in case of three levels of perception was revealed. The χ^2 test being non-significant leads to infer that family composition is independent of perception level about sustainability in agriculture.

ii. Family type :

Family composition and family type are interrelated in many of the social aspects. The present day living tends to be nucleus type over the joint family system. The joint system of living is fading at present. The table given below contains information about type of family of the sample under study.

Table 23: Family type and perception of sustainability in agriculture(n=200)

Sl. No	Family type	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Nucleus	26	61.90	48	44.44	32	64.0	106	53.0	191.45*
2	Joint	16	38.10	60	55.56	18	36.0	94	47.0	
3	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

The results contained in table above presents a clear picture of family type under low, medium and high level perception groups. The joint family system is higher (55.56%) over nucleus one in case of medium group. On the whole, the nucleus family composition is found to be higher (53.0%) over joint system one (47.0%). The χ^2 value being significant reveals a positive association between type of family and level of perception in the matter of sustainability of agriculture.

iii. CASTE :

The caste continued to be one of the influential factors of activities of individuals in the society. Many studies have proved beyond doubt that influence of caste on individual in society continued to play important role. The present study while attempting to analyze relationship between level of perception and caste structure the following results were obtained.

Table 24: Caste and perception of sustainability in agriculture (n=200)

Sl. No	Caste	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	ST	0	0	0	0	0	0	0	0	23.98*
2	SC	14	33.33	8	7.41	2	4.00	24	12.00	
3	OBC	14	33.33	48	44.44	20	40.00	82	41.00	
4	Others	14	33.34	52	48.15	28	56.00	94	47.00	
5	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

The sample under study consisted mostly of OBC and other caste to the tune of 41% and 47% respectively with SC upto 12%. Further, it is observed that OBC and other caste dominated mostly under medium level of perception. The Chi square test being significant ($\chi^2 = 23.98$), the inference is drawn that caste structure influences the formation of perception of the small farm operators on sustainability in agriculture.

iv. Membership in formal organization:

Today in rural Orissa, innumerable organizations are coming up to participate in development process. The small farmers are to become members to fulfill the professional as well as social requirements. On the other hand, membership in organization is an indication of progressiveness. Examining the situation with the sample under study the following results are obtained.

**Table 25: Membership in formal organization and perception of sustainability
In agriculture (n=200)**

Sl. No	Membership	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Up to 2	12	28.57	33	30.56	21	42.0	66	33.00	24.186*
2	3 to 4	13	30.95	52	48.15	29	58.0	94	47.00	
3	No membership	17	40.48	23	21.29	0	0	40	20.00	
4	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

A glance of the table reveals that as much as 47% of sample are members in three to four organizations followed by 33% up to two organizations while 20% did not have any membership. Moreover, all the respondents under high level of perception were members where as non-members were found in case of low and medium perception level. The calculated value of Chi square value being significant ($\chi^2 = 44.186$), membership is found to be related to perception level of the sample.

1.4. ECONOMIC FACTORS :

The study conducted on socio-economic parameters reveal many kinds of classifications. So far as economic factors are concerned, considering the relevance of the sample, the economic factors consisted of as much as eight variables consisting of land holding, occupation, irrigation, crops grown, livestock, additional source of income, use of energy and farm implements. The study did not include annual income of the

small farm families as such information are not found to be reliable as indicated by many of the studies conducted in Orissa.

i. Land Holding :

The households of farming communities are classified into small, marginal and large farm families by the Govt. on the basis of their land holdings. The families possessing one to two hectors of land are further classified at micro level. The study attempted to examine distribution of sample on five levels of land holding starting from one acre to 5 acres of land.

Table 26: Land holding and perception of sustainability in agriculture (n=200)

Sl. No	Land holding (Ac)	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Up to 1.0	4	9.52	1	0.93	0	0	5	2.50	14.3587 N.S.
2	1.1 ~ 2.0	15	35.71	32	29.63	14	28.0	61	30.50	
3	2.1 ~ 3.0	12	28.57	35	32.41	15	30.0	62	31.00	
4	3.1 ~ 4.0	9	21.43	24	22.22	13	26.0	46	23.00	
5	4.1 ~ 5.0	2	4.76	16	14.81	8	16.0	26	13.00	
6	Total	42	100	108	100	50	100	200	100	

The distribution of sample reveals that maximum respondents have land within 3.1 – 4.0 acres followed by 2.1 to 3 acres and 1.1 to 2.0 acres. However, the data under Chi square test is found to be non-significant. The homogeneity of sample on landholding size irrespective of districts is the reason for this. It is so because the sample was drawn as per classification of state Govt. on the specifications of parameters of small and marginal farm families.

ii. Occupation:

Occupation of small farmers is farming. With emphasis on diversification, there has been difference at micro level in the matter of occupational profession. It is common observation at villages of Orissa that families earn their livings from more than one

occupations like business and service In finding out the distribution of sample under service, business and farming occupations the following results are obtained.

Table 27: Occupation and perception of sustainability in agriculture (n=200)

Sl. No	Occupation	Low		Medium		High		Total		χ^2 Value
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	
1	Service	3	7.14	8	7.41	6	12.00	17	8.50	1.787 N.S.
2	Business	1	2.38	6	5.56	2	4.00	9	4.50	
3	Farming	38	90.48	94	87.03	42	84.00	174	87.00	
4	Total	42	100	108	100	50	100	200	100	

Occupation as a variable is found to be independent of perceptual level about sustainable agriculture. The distribution of sample against the occupations of service, business and farming was found to be 8.50%, 4.50% and 87.0% respectively. Invariably, the distribution of sample is found to be higher in case of farming irrespective of level of perception.

iii. Area under Irrigation :

It was observed during investigation that small farmers in coastal tract of Orissa have some land under irrigation facilities either for crops or vegetables using various sources. The sample being homogenous in nature and irrigation found to be constant factor with all the sample (100%), for which differential response was not obtained. This leads to conclude that all small farmers under study have area under irrigation irrespective of magnitude and crops.

4. Crops grown:

The cropping intensity in Orissa is 148% which indicates more than one crop is taken in many areas. The coastal ecosystem of state is enriched with availability of under ground water. Under ground water sources tend farmers to take more than one crop per year. Analysis of data collected in this context appear in the following table.

Table 28: Crops grown and perception of sustainability in agriculture (n=200)

Sl. No	Crops grown	Low		Medium		High		Total		χ^2 Value
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	
1	Mono crop	4	9.52	16	14.81	9	18.00	29	14.50	3.026 N.S.
2	2 crops	35	83.33	78	72.22	37	74.00	150	75.00	
3	3 crops	3	7.14	14	12.96	4	8.00	21	10.50	
4	Total	42	100	108	100	50	100	200	100	

Findings reveal that majority of sample (75%) of small farm operators take two crops per year followed by 14.5% who practice mono crop and 10.5% take more than three crops. As the χ^2 test was found to be non-significant, owing to homogeneity in cropping pattern in coastal area of the state under study, it is inferred that taking number of crops per year and formation of perception are not positively related.

v. Animal wealth :

Livestock is an integral part of farming system in the state. It is normally observed that those who undertake farming must have livestock of any kind to support farm operations. While examining the situation of sample under study the following results were obtained.

Table 29: Animal wealth and perception of sustainability in agriculture (n=200)

Sl. No	Animal wealth	Low		Medium		High		Total		χ^2 Value
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	
1	Less than 4 animals	12	28.57	32	29.63	17	34.00	61	30.50	0.396 N.S.
2	4 & above 4 animals	30	71.43	76	70.37	33	66.00	139	69.50	
3	Total	42	100	108	100	50	100	200	100	

The results revealed that as much as 69% possess more than 4 animals against 34.5% who have up to 4 animals. The possession is higher in case of low perception

group followed by medium and high. The occupation relating livestock does not get affected so much as in case of crops, may be the reason for distribution of high percentage of respondents in low and medium perception group. In other words, respondents coming under low perception group keep more animals who support their farming operations. However, χ^2 test is not significant revealing no relationship between animal wealth and perception about sustainability in agriculture.

vi. Additional source of income :

Additional source of income is related to diversifications in the traditional methods of farming. With increase of extension inputs there has been a change in traditional system of farming adding livestock and fishery as source of additional income. Moreover, livestock and fishery are important components of farming system in coastal tract of Orissa. On identifying the position of livestock in case of sample farmers following information are revealed.

Table 30: Additional source of income and perception of sustainability in agriculture

Sl. No	Additional Income source	Low		Medium		High		Total		χ^2 Value
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	
1	Only livestock	40	95.24	94	87.04	41	82.00	175	87.50	3.703 N.S.
2	Livestock & fishery	2	4.76	14	12.96	9	18.00	25	12.50	
3	Total	42	100	108	100	50	100	200	100	

Of the sample 87.5% have only livestock to support farming and income where as 12.5% have fishery in addition to livestock. It is more in case of respondents of medium and high level of perception. The χ^2 value is not significant owing to reasons of limited farmers have fishery as additional component of family income.

vii. Use of energy :

Use of energy is of recent importance in farming system in the state. With introduction of new agriculture policy and increase in subsidy for the farming sector energy use in form of electricity, diesel or petrol was increased over the past years. The study attempted to find out use of energy among the small farm operators in coastal ecosystem of Orissa. It is observed that out of sample, only 24.5% use energy against 75.5% who do not use energy in farm operations.

Table 31: Use of energy and perception of sustainability in agriculture (n=200)

Sl. No	Energy use	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Yes	2	4.76	31	28.70	16	32.00	49	24.50	11.398*
2	No	40	95.24	77	71.30	34	68.00	151	75.50	
3	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

The results show that there is significant relationship between use of energy and perception about sustainability in agriculture. However, the per capita consumption of energy has not taken into considerations which would have been revealed additional information.

viii. Farm machinery :

Use of farm machinery is given more importance to meet the shortage of labor in the state and reduce the cost of production. With emphasis on agro-industries in the state, the use of tractor, power tiller, winnower, reaper and sprinkler etc. has been increased invariably. More over, there is also gap in use and possession of farm machinery as many prefer to hire these at the time of need. The concept has been further enriched by establishment of agro-clinic at different parts of the state. The study attempted to find out possession of farm machinery among the sample as contained in the table below.

Table 32: Possession of farm machinery in agriculture (n=200)

Sl. No	Name of farm machinery	Frequency (f)	Percentage (%)
1	Tractor	6	3.00
2	Power tiller	18	9.00
3	Reaper	0	0
4	Thresher	11	5.50
5	Winnower	34	17.00
6	Sprinkler	0	0
7	Sprayer	117	58.50
8	Mould Board plough	165	82.5

It is observed that 6 numbers (3%) of small farmers have tractors, 18 numbers (9%) have power tiller while as much as 117 numbers (58.5%) have sprayers and 34 numbers (17%) have winnower in the area under study. Thresher and M.B. plough found to be with 5.5% and 82.5% of the sample respectively. The inference of the table is that the costly farm machinery are hardly possessed by the sample under study for the reason of cost and skill to operate.

1.5. COMMUNICATION BEHAVIOUR:

Mass media are the major sources of information for the farmers in village areas. All the mass media now have specific time and space for farm information. The present observation reveals that small farmers mostly use radio, TV and news paper to gather technical information about the farm practices they wish to undertake. The relation between use of mass media and level of perception of the respondents appear in table below.

Table 33: Exposure to mass media and perception of sustainability in agriculture

Sl. No	Exposure to mass media	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Exposed	34	80.95	102	94.44	48	96.00	184	92.00	8.929*
2	Not exposed	8	19.05	6	5.56	2	4.00	16	8.00	
3	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

A look at the table reveals that 92% of the sample is well exposed to different mass media like newspaper, TV and radio, against 8% who are not well exposed. Further, the respondents of medium level of perception are more exposed to mass media than those of low perception group. Chi square value being significant confirms to the findings of others that mass media regulates the formation of perception about sustainability of agriculture to a significant level.

1.6. MARKETING BEHAVIOUR

Marketing is now an integral part in taking decisions. Irrespective of level of farming market is an important input to sustain the level of productivity and income of the farmers. The present study included three important components namely, marketable produce, opinion about sale price and place of market of farm produce.

i. Marketable produce :

Small framers possess small land holdings but make intensive use of it. In many cases the Cropping intensity in coastal area of Orissa is more than 300% in case of small farmers. Farmers grow more cash crops beside cereal to sell and earn living. In analyzing the opinion of the respondents about marketable farm produce at house hold level the following information were obtained.

Table 34: Marketable farm produce and perception of sustainability in agriculture (n=200)

Sl. No	Farm produce	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Just manageable	8	19.03	11	10.19	2	4.00	21	10.50	6.569 N.S.
2	Little over family maintenance	32	76.19	85	78.70	43	86.00	160	80.00	
3	Much more than family requirement	2	4.76	12	11.11	5	10.00	19	9.50	
	Total	42	100	108	100	50	100	200	100	

Data in table above reveal that about 80% have little surplus over the family requirements to sell in market, where as 10.5% mentioned that their produce is just manageable. About 9.5%of mentioned production more than family requirement. The χ^2 test is not significant as the sample is homogenous in land holding and production level.

ii. Opinion about sale price:

Sale of farm produce on remunerative price act as parameter for assessing the sustainable production and productivity. Many of the small farm operators report that whatever produce they sell in the market do not compensate to cost of production. In many parts of the state more production has become a problem with farmers because of non-existence of regulated market. In examining the opinion of the respondents about remunerativeness of farm produce the following information were received.

Table 35: Opinion about sale price and perception of sustainability in agriculture

(n=200)										
Sl. No	Opinion	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Remunerative at times	12	28.57	29	26.85	10	20.00	51	25.50	22.404*
2	Quite remunerative	0	0	17	15.74	6	12.00	23	11.50	
3	Not remunerative	21	50.00	54	50.00	34	68.00	109	54.50	
4	Less concern	9	21.43	8	7.41	0	0	17	8.50	
5	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

A majority of the sample (54.5%) expressed farm produce as not remunerative while 25.5% mentioned as remunerative against 8.5% who are less concerned about the sale price. Farm produce as quite remunerative was mentioned by 11.5% sample. The calculated Chi square value reveals a significant value indicating relationship between perception and opinion about sale price among the sample under study.

iii. Place of marketing :

The disposal of farm produce is an important aspect in sustainability in agriculture. A number of studies have indicated adoption of technology and place of marketing of farm produce are interrelated. In examining the place of market of farm produce under the sub items of own locality, outside locality and out side district in the state, the following results were obtained.

Table 36: Place of marketing and perception of sustainability in agriculture (n=200)

Sl. No	Market place	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Own locality	18	42.86	27	25.00	30	60.00	75	37.50	25.497*
2	Outside locality	24	57.14	78	72.22	16	32.00	118	59.00	
3	Outside district	0	0	3	2.78	4	8.00	7	3.50	
4	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

Findings reveal that only 3.5% of the sample farmers of medium and high level of perception could establish market links outside the district where as 59% sell out side of own locality and 37.5% in own localities. The farm produce being small quantities, the distant market link is probably not required for which such results have been obtained. As hypothesized, place of marketing of farm produce is related to the level of perception of small farmers (χ^2 test significant).

1.7. FARMING BEHAVIOUR:

Farming experience and responsibilities at farm level are almost same with all the respondents selected for study. They being the small farmers possessing equal size of farm growing similar type of crops and residing under similar eco-system are almost same in many aspects. Since all the farmers take farming as occupation and involve directly in farming process, the farming experience and responsibilities could not be identified as parameters to bring difference in perception level.

1.8. TRAINING

Training is another important component of present farming system in view of advancement in science and technology. It has been a policy of Govt. to provide training to farmers with evolution of new technology in the field of agriculture. The training availed by the sample under study is reflected in table below.

Table 37: Training undergone and perception of sustainability in agriculture

(n=200)

Sl. No	Training undergone	Low		Medium		High		Total		χ^2 Value
		f	%	f	%	f	%	f	%	
1	Yes	25	59.52	89	82.41	47	94.00	161	80.50	17.828*
2	No	17	40.48	19	17.59	3	6.0	39	19.50	
3	Total	42	100	108	100	50	100	200	100	

* Significant at 5% level of probability

Of the sample, 80.5% have availed training against 19.5% who did not. The frequency of training is more pronounced in case of high level of perception followed by medium and low level. The Chi square value being significant (17.828), the relationship between perception and training undergone is found to be interrelated.

1.9. VARIATION AT DISTRICT LEVEL :

The sample was drawn from coastal districts of Puri (D1), Khurda (D2), Ganjam (D3) and Balasore (D4). The variation among the sample of different districts have been calculated and presented below.

Table 38: Variation in the profile of sample of districts under study

Sl.No	Profile of sample	Districts				
		D1	D2	D3	D4	Average
1	PERSONAL					
i	Age	48	49.5	49.5	50	49.2
ii	Education	2.50 ^a	2.06 ^b	1.96 ^b	1.82 ^b	2.08

Sl.No	Profile of sample	Districts				
		D1	D2	D3	D4	Average
2	SOCIAL					
i	Family composition	5.54 ^a	6.14	6.30 ^b	6.70 ^b	6.17
ii	Family type	1.48	1.44 ^a	1.50 ^b	1.46	1.47
iii	Caste	3.30 ^a	3.42 ^b	3.34 ^a	3.34 ^a	3.35
iv	Membership in formal organisation	0.94 ^a	1.04 ^a	1.92 ^b	1.64	1.39
3	ECONOMIC					
i	Land holding	3.18 ^a	3.58 ^b	3.30 ^a	3.28 ^a	3.34
ii	Occupation	2.20 ^a	2.42 ^b	2.28	2.22 ^a	2.28
iii	Irrigation	2.58 ^a	2.32	2.52 ^a	1.89 ^b	2.33
iv	Crops grown	1.84 ^a	2.30 ^b	2.00	2.22 ^b	2.09
v	Animal wealth	1.22 ^a	1.28 ^x	1.30 ^b	1.22 ^{ay}	1.26
vi	Additional source of income	2.36 ^a	2.24 ^b	2.38 ^a	2.52	2.38
vii	Use of energy	1.26	1.24 ^a	1.34 ^a	1.14 ^b	1.25
viii	Farm implements	1.67 ^a	2.80 ^b	2.16	1.67 ^a	2.08
4	COMMUNICATION BEHAVIOUR					
i	Exposure to mass media	9.27 ^a	7.73 ^{bx}	8.93 ^a	9.06 ^y	8.75
5	MARKETING BEHAVIOUR					
i	Place of marketing	1.25 ^{ax}	0.88 ^b	0.78 ^b	0.89 ^y	0.95
ii	Opinion about sale price	2.30 ^a	2.52 ^b	2.42	2.30 ^a	2.34
iii	Marketable produce	1.92 ^a	2.08 ^b	2.04	1.92 ^a	1.99
6	FARMING BEHAVIOUR					
i	Experience in farming	1.92 ^a	1.94	1.96 ^b	1.96 ^b	1.95
ii	Farming responsibilities	3.10 ^a	3.20 ^a	2.98 ^x	3.68 ^{by}	3.24
7	TRAINING					
i	Training undergone	1.82	1.76 ^a	1.94 ^b	1.69 ^a	1.80
ii	Use of training knowledge	1.00	1.00	1.00	1.00	1.00

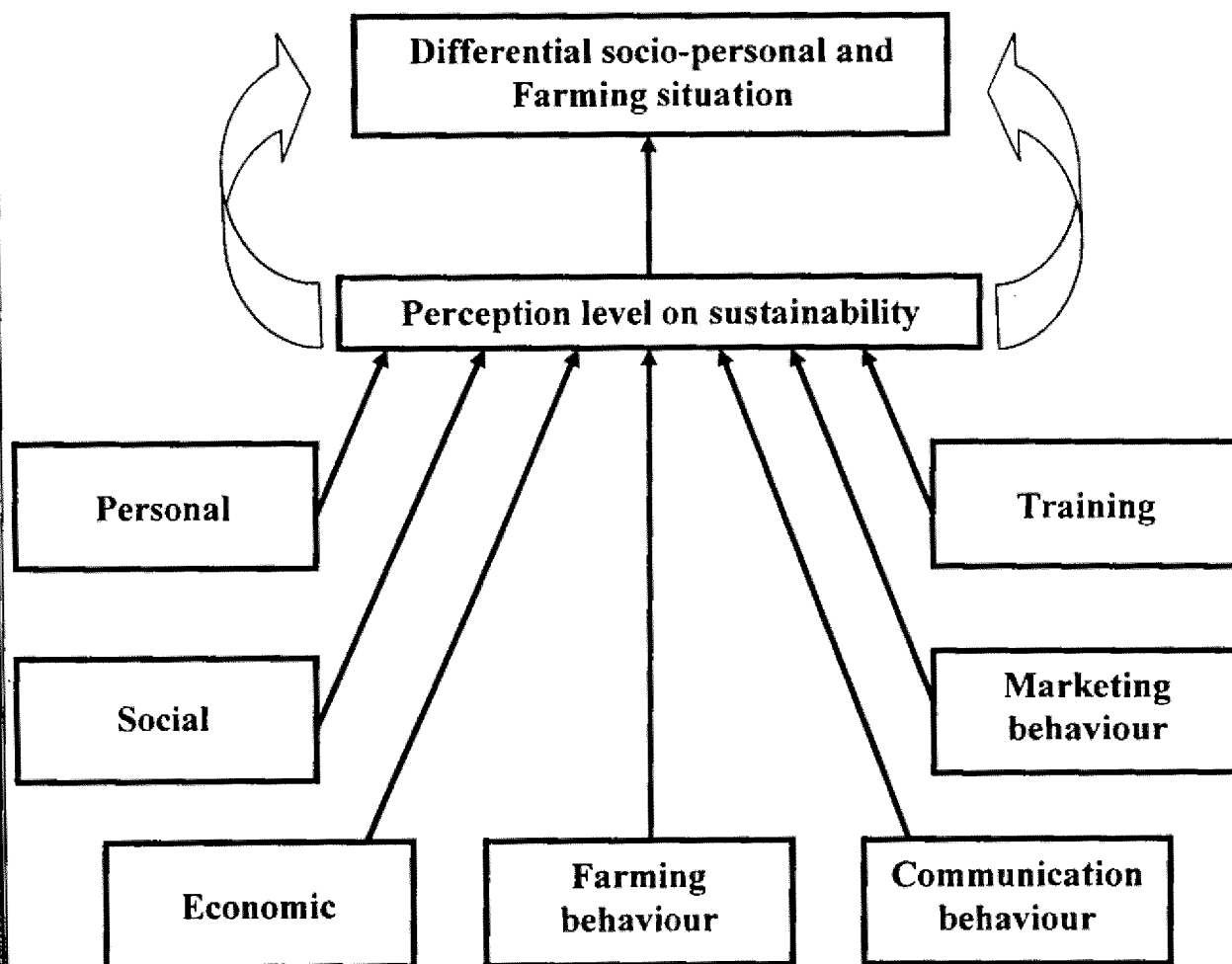
a,b and x,y : different Parenthesis indicate significant difference (p>0.05)

The findings of study revealed that:

1. Selection of sample at the district level with regard to age does not exhibit difference and hence selection of sample is appropriate.
2. With regard to education wise difference was observed among the districts of Puri, Khurda Ganjam and Balasore.
3. In case of family composition, the district Puri exhibited a difference with Ganjam and Balasore whereas in case of family type only difference was observed within Khurda and Ganjam.
4. In case of caste, the composition of Khurda was different with that of Puri, Ganjam and Balasore.
5. Membership in organization was found to be different between Puri and Ganjam and Khurda and Ganjam.
6. In case of land holding, Puri and Khurda, Khurda and Ganjam and Khurda and Balasore have significant difference.
7. Invariably Khurda observed to be different than Puri and Balasore in case of occupation.
8. With regards to number of crops grown, Puri has significant difference with Khurda and Balasore.
9. Possession of animal wealth is found to be different among three districts of Puri and Khurda, Puri and Ganjam, Khurda and Balasore and Ganjam and Balasore.
10. Additional sources of income equally found to be different among the small farmers of Puri and Khurda, Ganjam and Balasore.
11. District level variation was observed in case of Khurda and Balasore as well as Ganjam and Balasore in case of energy use.
12. Possession of farm machinery was different with sample of Puri and Khurda as well as Khurda and Balasore.

13. Absorption of information from mass media was found to be different among the sample of Puri and Khurda, Khurda and Ganjam as well as Khurda and Balasore.
14. Similarly place of marketing was significantly different in case of Puri, Khurda, Ganjam and Balasore.
15. The experience of farmers about sale price reveals difference among the farmers of Khurda between Puri and Balasore.
16. Marketable farm produce was differently viewed by the farmers of Puri, Khurda and Balasore districts.
17. Difference in training undergone is found in case of Ganjam, Khurda and Balasore.

Figure 3: Relationship between profile of sample and level of perception



OBJECTIVE – II

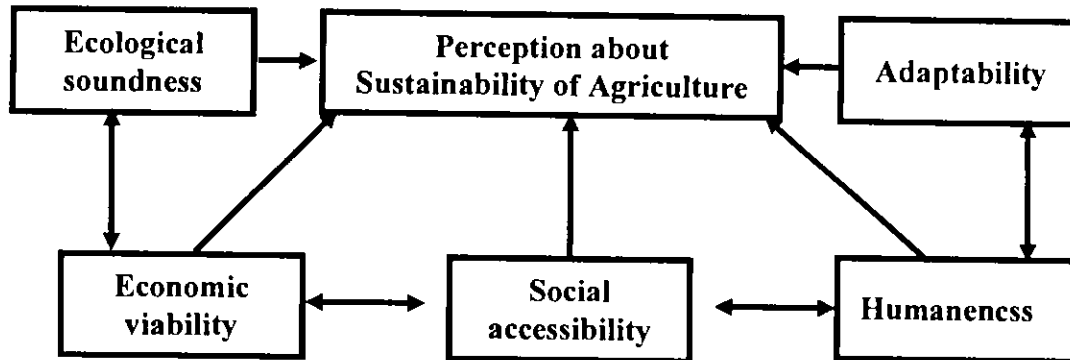
PERCEPTION OF SMALL FARM OPERATORS ABOUT SUSTAINABILITY OF AGRICULTURE AND GAP IN COMPREHENDING SUSTAINABILITY

SUSTAINABILITY IN AGRICULTURE

Sustainability essentially means meeting the needs of present generation without compromising the ability of future generation to meet their own needs. The concept used by FAO to convey the meaning of sustainability necessarily rely on management and conservation of resource base in relation to orientation of technological and institutional changes to ensure satisfaction in meeting human needs. Sustainability normally covers the meaning of conservation of natural resources. The natural resources are, land, water, forest and livestock. The maintenance of these resources suffer due to low or no maintenance because of absence of infrastructure and inadequate of finance. Apart from these constraints, poor management ability is also responsible for degradation of natural resources. To equip the people, in general, poor managerial ability has to be upgraded through multidisciplinary program, appropriate technology and establishment of peoples' organization. To work on sustainability as defined for maintenance and conservation the people in general ought to develop a positive perception to work before the program is initiated. The perception directs action of individual in a positive manner. Therefore it is necessary to determine the perception of people about the concept of sustainability, particularly in the field if agriculture.

The present study after thorough review of literature and consultation with experts in line (Sabarathnam, 2002) five important factors were identified to examine the perception level. Illustration given below reveals the inter dependency of the factors at micro level to form the perception of the people about the sustainability in agriculture.

Figure 4: Relationship among Factors of sustainability in agriculture with formation of Perception



FACTORS OF SUSTAINABILITY IN AGRICULTURE

The factors namely ecological soundness, economic viability, social accessibility, humaneness and adaptability of technology were selected for the study to find out the relative position of these factors in assessing the perception score about sustainability in agriculture. The ranking of factors in accordance with their relative influence on sustainability in agriculture, as rated by the respondents are presented here within.

Table 39: Ranking of factors in sustainability in agriculture

Sl. No	Factors of sustainability	Low	Medium	High	Average	Rank
1	Ecological soundness	3.36	3.50	3.70	3.52	II
2	Economic viability	3.88	3.83	3.82	3.84	I
3	Social accessibility	2.69	2.66	2.76	2.70	III
4	Humaneness	2.09	2.24	2.04	2.12	V
5	Adaptability	2.50	2.35	2.28	2.38	IV

A glance at the table reveals that respondents under low perception, rated economic viability followed by ecological soundness, social accessibility, adaptability and humaneness as the important factors of sustainability in order. The sample under medium level of perception viewed similarly all the factors under study. The difference was also not marked in case of high perception groups, on economic viability as followed by ecological soundness, social accessibility, adaptability and humaneness. Taking all the response into account, the average scores reveal that economic viability tops the rank followed by ecological soundness, social accessibility, adaptability and humaneness. However, in all the cases, humaneness as a factor of sustainability is ranked last indicating that in the case of development the weightage of humaneness is not counted much. It is further inferred that in the face of development and survival of the present sample, ignore all other factors except economic viability to meet the requirements of the present generation. The sample under study considers economic viability as the single most important factors that decide what kind of sustainability is required to sustain the present farming system.

Next to economic viability, ecological soundness is ranked second as it covers natural resources like soil, water, forest and livestock which are life supporting system of rural people. The social accessibility in the scale of rich and poor does not affect much as all the respondents belong to small and marginal farm families having similar accessibility to natural resources irrespective of district and state. However, the adaptability of recent recommendations to restore sustainability occupies fourth position indicating its position among the five important factors. This factor is related to economic viability as farmers weigh the profit and loss before taking up measures to sustain natural resources which forms the core aspect of the study.

However, the ranking of factors of sustainability in agriculture under rank-order correlation did not reveal any significant relationship among levels of perception of low, medium and high groups. In other words the ranking of factors of sustainability are viewed equally by the sample under study irrespective of their perception level.

2.1. ECOLOGICAL SOUNDNESS

The most important aspect of sustainability is conservation and maintenance of ecosystem. *The realization at different levels about the degradation of natural resources* directly or indirectly point out to the ecological component of the place. The study attempted to find out reaction of the sample regarding ecological factors that concern more to small farmers. The statements selected for recording response are given in Table below.

Table 40: Ecological soundness and reaction of the sample

Sl. No.	Statements	Average	Rank
1	The soil condition of an area with regards to its structure, fertility and level of organic matter reveal the soundness of the ecology	3.51	III
2	Availability of ground water and its nearness to root zone of crops indicate good ecological status.	2.70	VI
3	The maintenance of nutrients of soil in form of NPK and other minor elements helps to have sound ecology of an area.	2.92	V
4	Types of farming including crop rotation, land use pattern etc are the main indicators of ecological soundness leading to sustainability.	3.31	IV
5	Use of organic fertilizers such as FYM, compost and Green manuring leads to good ecology and sustainability in agriculture	3.95	I
6	Use of bio-pesticides and fungicides add to maintenance of ecological soundness	3.54	II
	Average	3.32	

The table reveals that the average score of all the statements qualifying attributes of ecological soundness is found to be 3.62. On the basis of the score, the ranking of the statements revealed that people are more concerned about “Use of organic fertilizers such as FYM, compost and Green manuring leads to good ecology and sustainability in agriculture”. It is so because the farmers of Orissa are in use of organic manures since from many generations. The next rank was assigned to “Use of bio-pesticides and fungicides add to maintenance of ecological soundness”. The use of pesticides has invariably created a negative attitude among the farmers about its effect have far spreading consequences. The third position was assigned to “The soil condition of an area with regards to its structure, fertility and level of organic matter reveal the

soundness of the ecology". The soil status of coastal belt has been affected due to continuous application of chemical fertilizers for which the sample perceived its condition directly related to soundness of ecology. The next position was assigned to types of farming in terms of "Types of farming including crop rotation, land use pattern etc as the main indicators of ecological soundness leading to sustainability". The farmers believe that age old practices of crop rotation, land use pattern, cultural practices not only keep the soil condition at desirable level but also adds to soundness of ecology.

The availability of ground water and its nearness to root zone was found to be sixth indicator of identifying different aspects of ecology. The farmers under study realize that the ground water once was available at the root zone of the crops now is depleting at some places. This indicator of ecological soundness was realized very well by the sample under study. The fifth rank item was "Maintenance of nutrients of soil in form of NPK and other minor elements help to have sound ecology of an area". It is observed that the farmers are acquainted with application of chemical fertilizers and count level of NPK as good indicator of ecological soundness.

Summarizing the table above, it may be inferred that use of organic manures, bio-pesticides and fungicides, good soil condition, traditional farming system like crop rotation, maintenance of nutrients in soil and making ground water available at root zone of crops are the major elements to keep ecology of a place sustainable.

2.2. ECONOMIC VIABILITY

The present day living depends upon successful use of natural resources. It is argued that for development of society the natural resources have to be manipulated otherwise development cannot be sustained. To have immediate economic benefit there is tendency among people to manipulate and use natural resources without thinking of

future generation. The different aspects of economic viability, were examined on a five point scale as contained in the table below.

Table 41: Economic viability and reaction of the sample

Sl. No.	Statements	Average	Rank
1	Level of production and its stability are important factors of economic feasibility that leads to sustainability	3.49	I
2	Conservation of natural sources is an important factor to have economically feasible agriculture	3.46	II
3	Increase in profitability in the existing farming system leads to economic feasibility	3.39	III
4	Sustainable agriculture provides enough income to meet the requirement of family	3.36	IV
5	Livelihood management consisting of animal and crop component on a profitable manner indicates the economic feasibility leading to sustainability	3.31	VI
6	Cost effectiveness of technology	3.32	V
	Average	3.39	

The overall obtained score is 3.39 of all the six statements qualifying attributes of economic viability. The ranking of statements reveals that level of production and its stability (3.49) is the most important factor to look at economic viability of sustainability in agriculture. It is so because the small and marginal farm families mostly depend on farming and limitations on the basis of production level and stability over the years have concerned them more. The stability of production and productivity of coastal area of Orissa is found to be unstable due to natural calamities which require a sound technology to provide economic viability of agriculture. The second position was assigned to "Conservation of natural sources is an important factor to have economically feasible agriculture". The farmers under study carry the idea of natural resources like land, water, forest and livestock if are not maintained, the economy of middle class farm

families will be greatly affected. The statement “Increase in profitability in the existing farming system leads to economic feasibility” is preferred to be in third position (3.39) because economic viability for the farmers is nothing but net profit. Profitability of technology in agriculture is the foremost consideration for which farmers have assigned third position to it as component of sustainability. The fourth position (3.36) is assigned to enough income “Sustainable agriculture provides enough income to meet the requirement of family”. The “enough” is operationalised in terms to meet the family requirement under rural condition. All these factors being interrelated are with slight difference in providing relative importance of perception. The fifth (3.32) and sixth (3.31) position were assigned to the statements “Livelihood management consisting of animal and crop component on a profitable manner indicates the economic feasibility leading to sustainability” and “Cost effectiveness of technology” respectively. It is natural that to have meaningful living, crop production alone can not meet the increasing financial requirement of the farm families. Crop livestock and fisheries etc are equally important to make agriculture sustainable as inter dependent components.

2.3. SOCIAL ACCESSIBILITY

The term social accessibility is operationalised under the study as the degree to which each and every family in the locality have accessibility to common resources. The variable ‘social accessibility’ was considered for the study in the matter of agriculture, and the village resources which support availability of common resources have been discussed in the table below.

Table 42: Social accessibility and reaction of the sample

Sl. No.	Statements	Average	Rank
1	Sustainability in agriculture ensures accessibility of all families to consume village resources.	3.60	I
2	Availability and use of energy in agriculture is an important component of social accessibility leading to sustainability in agriculture	3.43	II
3	To maintain sustainability adequate technical / technological support is necessary	3.32	V
4	Availability of capital at local level indicates social accessibility for sustainable agriculture	3.36	III
5	Sustainability of agriculture opens wide scope in marketing of farm produce.	3.35	IV
6	Participatory decision making for use of common resources in village is another important outcome of sustainability	3.26	VI
	Average	3.39	

Data in table above reveal that social accessibility is operationalised in terms of accessibility of all the farm families to common village resources, use of energy in agriculture, adequacy of technological support, capital, marketing and participatory decision making of their considerations assigning first position (3.60) followed by use of energy in agriculture, availability of capital, technological support, market facilities. The ranking of components was found to be in relative position in locality point of view. To have sustainability in agriculture in coastal areas of Orissa accessibility and allied facilities for all and use of energy in agriculture like electricity should be made available. The other factors like credit support, marketing, technical guidance and participatory approach which have been emphasized are really understood as have been reacted by them.

2.4. HUMANENESS

The development ultimately aims at humaneness in the society. With change of time, the concept of development centers around humaneness consisting of honesty, value system, cordial relationship, respect for honorable living, climate of trust worthiness, compassion and social solidarity. It is expected that sustainability in agriculture depends upon these qualities of humaneness. The reaction of sample farmers towards attributes of humaneness was examined as reflected in table below.

Table 43: Humaneness and reaction of the sample

Sl. No.	Statements	Average	Rank
1	Humaneness comes where respect for honesty and value system operates	3.55	I
2	It develops cordial relationship among different communities	3.53	II
3	Sustainability implies respect for honorable living	3.31	V
4	Sustainability can create climate of trust worthiness	3.42	III
5	Sustainability of agriculture creates opportunity for compassion	3.29	VI
6	Social solidarity is outcome of the Sustainability in agriculture	3.35	IV
	Average	3.41	

The sample as a whole viewed respect, honesty and value system at the top (3.55) followed by cordial relationship (3.53), climate of trust worthiness (3.42), social solidarity (3.35), respect to honorable living (3.31) and opportunity for compassion (3.29). The people of Orissa are religious and lead a simple life. The tradition of the social system in Orissa contains all these good attributes as have been ranked above. The value system in agriculture is more rigid while honour, honesty and cordial relationship among the groups and climate of trustworthiness prevail at higher rate among the people of Orissa as have been reflected as indicator of sustainability. However creation of compassion for others is the least preferred item.

2.5. ADAPTABILITY OF SUSTAINABLE MEASURES

Now-a-days there have been much research and extension effort to achieve sustainability in agriculture as it is the major component of life supporting system. Recommendations and technologies evolve at different parts of the country and outside are to be adopted with refinement to arrest degradation of natural resources. The present study considered progressiveness, accommodation of Government policy, technological change, increase in market demand, consumer preference, social conflict and disaster management in the context of adaptability of technology. The reaction of the sample to these attributes are given in the following table.

Table 44: Adaptability and reaction of the sample

Sl. No.	Statements	Average	Rank
1	Sustainability is achieved where villages tend towards progressiveness.	3.48	I
2	Sustainability emphasizes accommodation of Government policy and technological change.	3.37	II
3	Sustainability makes market demand widened.	3.30	IV
4	Consumer preference is important to have Sustainability in agriculture	3.32	III
5	Possible conflicts arise in adoption of Sustainability methods / practices and measures	3.29	V
6	Sustainability provide scope for disaster management	3.37	II
	Average	3.35	

The results reveal the progressiveness (3.48) as first factor of adaptability followed by disaster management (3.37), acceptance of Government policy (3.37) and consumer preference (3.32) to have sustainability in agriculture. The least preferred item was found to be possible social conflict next to creation of market demand for adoption

of technology. These attributes are essential as have been reported by authors in field of social research. Adoption of technology without putting people towards progressiveness carry little value for the people of coastal belt of Orissa.

2.6. GAP IN PERCEPTION

Summarizing the findings of the reacted values on five important components like ecological soundness, economic viability, social accessibility, humaneness and adaptability of recommendations the gap was calculated as mentioned below.

Table 45: Gap in percentage about the sustainability in agriculture (n=200)

Sl. No	Factors of sustainability	No. of statements	Max. obtainable score	Scores obtained	Gap %
1	Ecological soundness	6	30.00	19.96	33.47
2	Economic viability	6	30.00	20.37	32.10
3	Social accessibility	6	30.00	20.23	32.57
4	Humaneness	6	30.00	20.27	32.43
5	Adaptability	6	30.00	20.15	32.83
		Average	30.00	20.19	32.70

The data analyzed in the table above revealed that all the five factors tend to have a gap upto 32.70% in average, maximum being in case of ecological soundness and minimum in economic viability. The farmers being homogenous and the factors of sustainability being familiar to majority of respondents the gap appears to be same in almost all the cases. In other words about 67.00% of the samples are aware of factors of need to have sustainability in agriculture.

2.7. CORRELATION OF SUSTAINABILITY FACTORS

The sustainability factors like ecological soundness, economic viability, social accessibility, humaneness and adaptability are found to have relationship on overall perception of sample under study. As has been indicated earlier, the samples are categorized into high, medium and low level. The possible relationship between factors of sustainability and perception was worked out as reflected in the following table.

Table 46: Factors and perception of sustainability in agriculture (n=200) ('r' Value)

Sl. No	Factors of sustainability	Low	Medium	High	Total
1	Ecological soundness	0.393	0.083	0.189	0.541*
2	Economic viability	0.055	0.182	0.375	0.496*
3	Social accessibility	0.265	0.369	0.404	0.507*
4	Humaneness	0.139	0.089	0.612	0.553*
5	Adaptability	0.077	0.336	0.459	0.428*

* Significant at 5% level of probability

As revealed in table above the perception score at high level is found to be positively associated with economic viability, social accessibility, humaneness and adaptability whereas ecological soundness was found to be not significant.

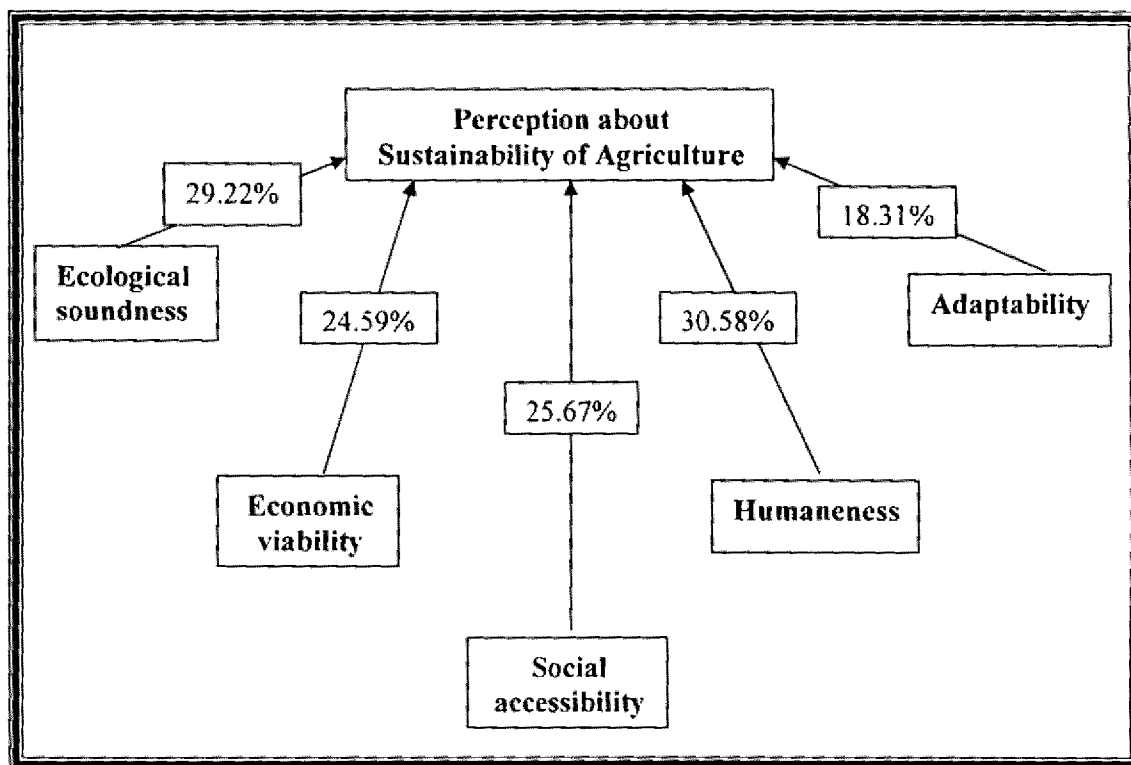
In case of middle level perception social accessibility and adaptability were found to be co-related while at lower level it is only ecological soundness and social accessibility. In other words, ecological soundness at high level and medium level is not found to be positively associated with perception as in case of low level. However, at overall level all the factors exhibited positive correlation indicating that all the five factors as described above have direct relationship with formation of perception about sustainability in agriculture by small farm operators.

Table 47: Percentage contribution of factors of sustainability towards Sustainable agriculture

Sl. No.	Factors of sustainability	'r' – Value	R ² x 100
1	Ecological soundness	0.0541	29.22
2	Economic viability	0.496	24.59
3	Social accessibility	0.507	25.67
4	Humaneness	0.553	30.58
5	Adaptability	0.428	18.31

Further, attempt was made to find out relative contribution of factors of sustainability in agriculture with overall perception level. The findings are depicted in the figure indicated below.

Figure 5 : Perception about Sustainability of Agriculture



For forming perception, the factors like humaneness contributes maximum (37.46%) followed by adaptability (21.03%), social accessibility (16.32%), economic viability (14.43%). However, the contribution of ecological soundness was observed to be minimum (3.57%). The reasons for such findings account for (i) humaneness in terms of living, (ii) adoption of technology for progressiveness, (iii) social accessibility for use of common resources and (iv) profitability. All these four factors are directly or indirectly concerned with human beings in living system. Therefore, while forming perception, the humaneness factor surpassed the factor of ecological soundness.

Figure 6: Sustainable Agriculture Index of Villages under Study.

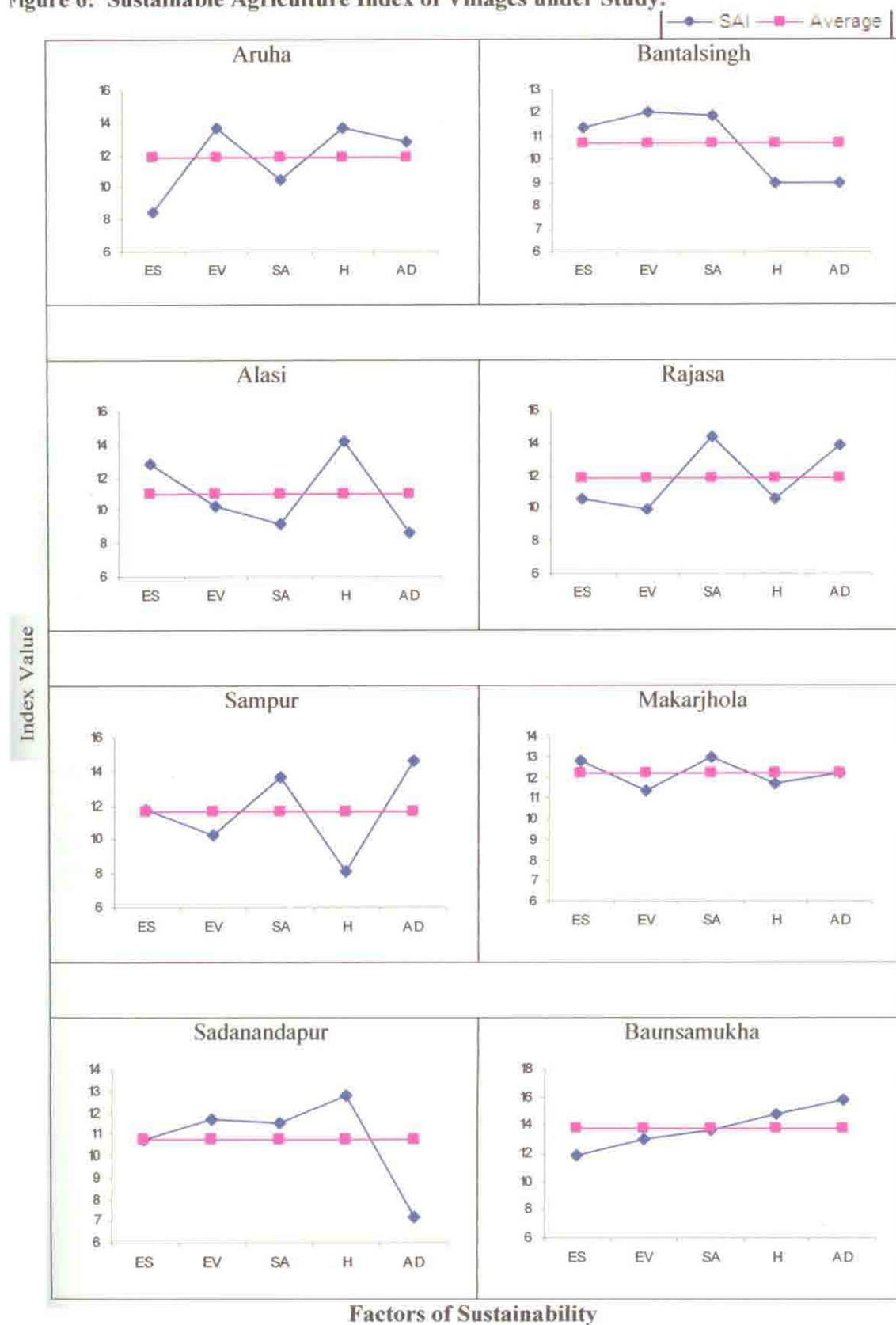
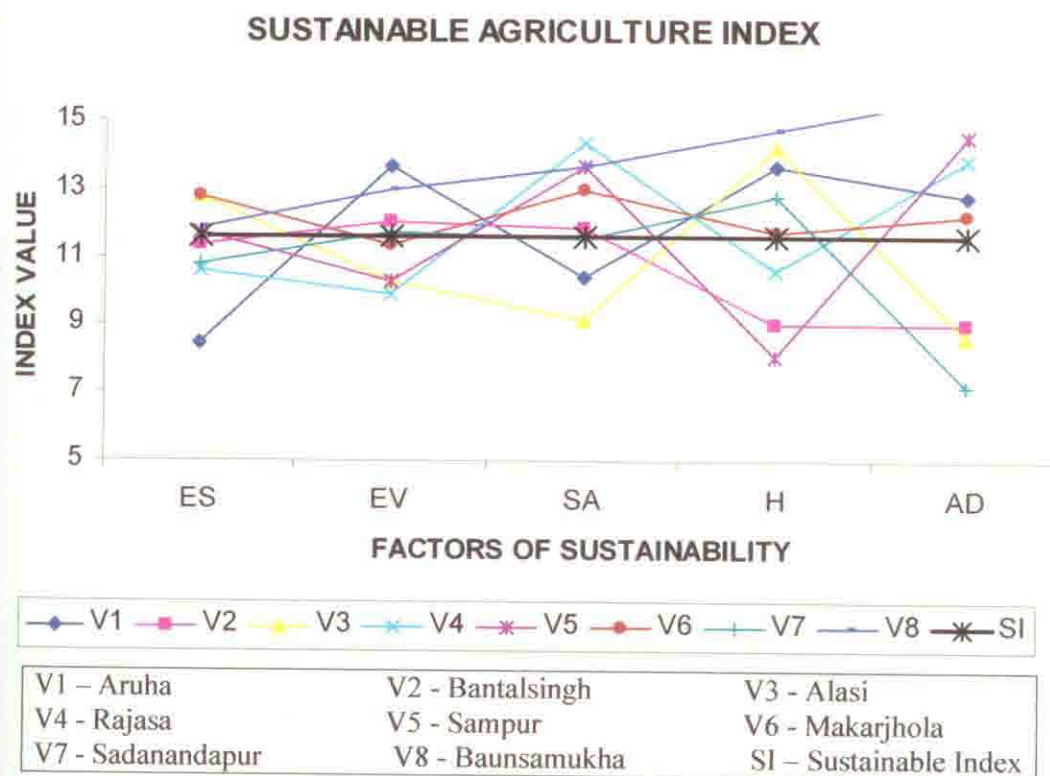


Figure 7: Sustainable Agriculture Index



OBJECTIVE - III

RELATIVE POSITION OF AREA UNDER SUSTANABLE AGRICULTURE INDEX (SAI)

It was within the interest of the study to find out relative position of the village surveyed under different districts in the scale of sustainable agriculture index. As was studied earlier the SAI has been worked out on the basis of five important parameters i.e. Ecological soundness (ES), Economic viability (EV), Social accessibility (SoA), Humaneness (IH) and Adaptability (Ad). Taking into consideration of these parameters developed by different authors on sustainability the above five factors decided to be used as parameters identified by Swaminathan (1991), Izac *et al.* (1992) and Reijntjes *et al.* (1992) for operational purpose. Attempt was made to study villages in the context of sustainable agriculture index under different blocks as have been described below.

Table 48: Villages under study

Sl. No.	District	Villages
1	Puri	1. Aruha 2. Bantalsingh
2	Cutack	1. Alasi 2. Rajasa
3	Ganjam	1. Sampur 2. Makarjhola
4	Balasore	1. Sadanandapur 2. Baunsamukha

3.1. Ecological Soundness :

Ecological soundness covers the aspects like soil condition, available ground water level, the type of farming, use of organic fertilizers and bio-pesticides. In calculating the sustainable index as have been indicated in the Chapter, 'Research

Methodology' (Page 70), the relative position of surveyed villages was found out as contained in Table below.

Table 49: Relative position of villages in SAI in terms of Ecological Soundness

Sl. No.	Villages	SAI	+ / - than average
1	Aruha	8.46	-
2	Bantalsingh	11.34	+
3	Alasi	12.78	+
4	Rajasa	10.62	-
5	Sampur	11.70	+
6	Makarjhol	12.78	+
7	Sadanandapur	10.80	-
8	Baunsamukha	11.88	+
	Average	11.30	

The data in the table above reveal that in the matter of Ecological soundness Makarjhol topped the list followed by Alasi, Baunsamukha and Sampur. However, Aruha possessed least ecological soundness in the scale of sustainable agriculture index.

3.2. Economic Viability :

The second important component of sustainable agriculture was considered to be economic viability which have been studied by International Green Front Report (1988), Reetz (1990), Board for International Food and Agriculture Development and Economic Cooperation (1991) and Swaminathan (1990). The present study considered the economic viability in the terms of level of production and its stability, conservation of natural resources, profitability, income and livelihood management. While determining the relative position of the villages covered under survey the following results were obtained.

Table 50: Relative position of villages in SAI in terms of Economic Viability

Sl. No.	Villages	SAI	+ / - than average
1	Aruha	13.68	+
2	Bantalsingh	12.06	+
3	Alasi	10.26	-
4	Rajasa	9.90	-
5	Sampur	10.26	-
6	Makarjhola	11.34	-
7	Sadanandapur	11.70	+
8	Baunsamukha	12.96	+
	Average	11.52	

Result revealed that the villages like Aruha, Baunsamukha, Bantalasingh and Sadanandapur had better economic viabilities than other villages in the list. However, Rajasa and Alasi were measured as the least in deriving the economic viability of the situation under study.

3.3. Social Accessibility:

Social accessibility as a factor of Sustainable Agriculture have been highlighted by the authors like Swaminathan (1992), Mendoza (1994), Reijntjes *et al.* (1992). The present study considered social accessibility in terms of accessibility of villagers, natural resource, use of energy in agriculture, availability of technological support, availability of capital at local level, market facility and participatory decision making habit of the respondents. In the scale of sustainable agriculture index the relative position of the sample villages yielded following informations.

Table 51: Relative position of villages in SAI in terms of Social Accessibility

Sl. No.	Villages	SAI	+ / - than average
1	Aruha	10.44	-
2	Bantalsingh	11.88	-
3	Alasi	9.18	-
4	Rajasa	14.40	+
5	Sampur	13.68	+
6	Makarjhola	12.96	+
7	Sadanandapur	11.52	-
8	Baunsamukha	13.68	+
	Average	12.22	

In the scale of social accessibility the villages like Sampur and Baunsamukha secured equal position followed by Makarjhola, Bantalasingh and Sadanandapur in order. However, Alasi and Aruha were found to be least preferred in the scale of social accessibility. It may be due to the fact that social accessibility in the context of sustainability in agriculture is not well understood by small farm operators covered under study.

3.4. Humaneness :

Humaneness has been highlighted by Sabarathnam (2002) and Swaminathan (1991) and other scientists as factors of sustainable agriculture index. Considering the local condition of the state, humaneness was measured in terms of respect for honesty, cordial relationship, honorable living, climate of trust worthiness, opportunity for compassion and social solidarity. In terms of these important ingredients the villages were mapped as observed in table below.

Table 52: Relative position of villages in SAI in terms of Humaneness

Sl. No.	Villages	SAI	+ / - than average
1	Aruha	13.68	+
2	Bantalsingh	9.00	-
3	Alasi	14.22	+
4	Rajasa	10.62	-
5	Sampur	8.10	-
6	Makarjhola	11.70	-
7	Sadanandapur	12.78	+
8	Baunsamukha	14.76	+
	Average	11.86	

The information contained in the table reveal that Baunsamukha occupied the first position followed by Alasi, Aruha and Sadanandapur respectively. However, Sampur and Bantalasingh were found to be at bottom on the scale. The overall analysis inferred that the humaneness is more valued in some villages of Balasore and Khurda.

3.5. Adaptability :

Appropriateness of technology is one of the important factors of sustainability in agriculture as have been identified by Swaminathan (1991), Kutty (1996). Scientists in the field of agriculture have unanimously agreed that appropriate technology is an essential element of sustainability in agriculture. The analysis pertaining to adaptability of recommended technologies as an important ingredient revealed following findings.

Table 53: Relative position of villages in SAI in terms of Adaptability

Sl. No.	Villages	SAI	+ / - than average
1	Aruha	12.78	+
2	Bantalsingh	9.00	-
3	Alasi	8.64	-
4	Rajasa	13.86	+
5	Sampur	14.58	+
6	Makarjhola	12.24	+
7	Sadanandapur	7.20	-
8	Baunsamukha	15.84	+
	Average	11.77	

Appropriateness of the technology to ensure sustainability in agriculture is valued high in Baunsamukha, Sampur, Rajasa, Aruha and Makarjhola respectively. Its value is not well realized in the villages of Sadanandapur, Alasi and Bantalasingh as revealed above. The appropriate technology as parameter of sustainability probably was not well understood in some of the villages covered under study (low score point).

Analysing the overall picture of ingredients of sustainability in agriculture the following information were obtained.

Table 54: Overall sustainable agriculture index (SAI) of the sample area

Sl. No.	Villages	SAI	Rank	+ / - than average
1	Aruha	11.75	IV	+
2	Bantalsingh	10.66	VII	-
3	Alasi	10.02	VIII	-
4	Rajasa	11.88	III	+
5	Sampur	11.66	V	+
6	Makarjhola	12.20	II	+
7	Sadanandapur	10.80	VI	-
8	Baunsamukha	13.82	I	+
	Average	11.59		

The findings revealed a mixed analysis of sustainable agriculture index of eight villages covered under study. As per sample selection and response of the sample variation has been observed in the district as well as village level. The overall picture reveals that Baunsamukha of Balasore district, Makarjhol of Ganjam district, Rajasa of Khurda district, Aruha of Puri district and Sampur of Ganjam district were found to be in order. The lowest position in the scale was found to be with Alasi of Khurda, Bantalsingh of Puri and Sadanandapur of Balasore district. Further in finding out difference between the districts in the scale of SAI the following results were obtained.

Table 55: ANOVA Table

Source	Sum of squares	Degree of Freedom	Mean sum of squares	F- value	Remark
Total	24.57	19			
Factors	1.956	4	0.489	0.308	N.S
Districts	3.541	3	1.180	0.743	N.S
Error	19.073	12	1.589		

As far as the factors taken into consideration to measure the SAI no significant difference was observed among the factors so also in case of districts under study.

OBJECTIVE - IV

RELATIVE POSITION OF SUB COMPONENTS OF FACTORS OF SUSTAINABLE AGRICULTURE AS PERCEIVED BY THE SAMPLE UNDER STUDY

In social research the use of different concepts and their related factors are not equally operationalised by the sample as well as researchers. The difference very often leads to confusion. The term 'Sustainable Agriculture' is of such nature that the farmers do not carry sense of meaning of it, as in case of experts. The present study made an attempt to find out such differences if any as has been described.

4.1. Ecological soundness

It was within the scope of study to enlist as many factors possible to define ecological soundness that could be included in the study. The response of the sample as well as experts in determining the relative position of subcomponents are given below.

Table 56: Sub-components of Ecological soundness

Sl. No.	Item	Sample		Experts		p-value
		Score	Rank	Score	Rank	
1	Soil	2.13	III	4.25	I	-0.61 N.S.
2	Water	1.74	VI	4.00	II	
3	Nutrient	1.84	V	2.75	III	
4	Types of farming	2.02	IV	2.75	III	
5	Use of Bio-pesticides and fungicides	2.14	II	2.25	IV	
6.	Use of organic manure	2.20	I	2.24	V	

As contained in the table above the sub-components under ecological soundness were found to be soil, water, nutrient, type of farming, use of bio-pesticides and fungicides and organic manure. The sample viewed use of organic manure as first important element followed by use of bio-pesticides and fungicides, soil, type of farming, nutrient and water in order. The judges ranked soil as first element followed by

water, nutrient, type of farming, use of bio-pesticides and fungicides and use of organic manure in order. The rank order correlation being non-significant the difference between the two groups of sample is not significant to make consideration while deciding the sub-components of ecological soundness.

4.2. Economic viability

Economic viability of sustainability in agriculture was studied under six dimensions like production, profitability, natural resource conservation, income, profitable crop and animal husbandry.

Table 57: Sub-components of Economic Viability

Sl. No.	Item	Sample		Expert		p value
		Score	Rank	Score	Rank	
1	Production	2.10	III	4.00	III	0.14
2	Profitability	2.38	I	5.25	I	
3	Resource conservation	2.02	V	3.50	IV	
4	Adequate income	1.97	VI	5.00	II	
5	Profitable animal husbandry	2.07	IV	2.00	VI	
6.	Profitable crop husbandry	2.26	II	2.25	V	

The ranking made by the two groups of sample is found to be equal in case of profitability and production with difference in opinion on other sub-components. However, the rank order correlation being non-significant there is no difference between the two groups of sample so far as sub-components of economic viability is concerned.

4.3. Social accessibility:

Social accessibility which can be obtained through sustainability in agriculture was measured in terms of access to common resources, use of energy, technological support, capital, market opportunity and participatory decision making. The differential ranking of farmers and experts is shown in table given below.

Table 58: Sub-components of Social accessibility

Sl. No.	Item	Sample		Experts		p Value
		Score	Rank	Score	Rank	
1	Accessibility to village resources	2.23	II	4.25	II	-0.31
2	Availability of energy for agriculture	2.61	I	2.75	V	
3	Technological support	2.08	III	2.50	VI	
4	Availability of Capital	1.96	VI	3.00	IV	
5	Market opportunity	2.06	V	4.75	I	
6.	Participatory decision making	2.07	IV	3.75	III	

A look at the table relating to the common accessibility to the village resources, both the samples are unanimous with difference in other sub-factors. However, rank order correlation being non-significant the study infers that both the groups are unanimous in rating the sub-components of social accessibility.

4.4. Humaneness

The core value of quality living is humaneness. As the study hypothesised that humaneness may emerge out of sustainability in agriculture, the aspects like respect for honourable living, cordial relationship, climate of trust worthiness, feeling for others and social solidarity were ranked by the two groups of sample.

Table 59: Sub-components of Humaneness

Sl. No.	Item	Sample		Experts		ρ Value
		Score	Rank	Score	Rank	
1	Respect for honourable living	2.18	I	5.25	I	0.81
2	Cordial relationship	2.14	II	3.25	II	
3	Honourable living	1.98	IV	2.75	IV	
4	Climate of trustworthiness	1.95	V	2.00	V	
5	Feeling for others	2.04	III	4.00	III	
6.	Social solidarity	2.04	III	3.75	III	

The rank order correlation reveals a non-significant result indicating that the difference between two groups is not valid. However, both the groups are unanimous in the matter of respect for honorable living, which sustainable agriculture should yield through society.

4.5. Adaptability

Adaptability has been operationalised the scope to accommodate change in agriculture, Govt. policy, market demand, consumers preference, conflict owing to adoption and scope for disaster management were considered under adaptability.

Table 60: Sub-components of Adaptability

Sl. No.	Item	Sample		Experts		ρ Value
		Score	Rank	Score	Rank	
1	Accommodation for social change	1.97	VI	5.00	I	-0.04
2	Accommodation for Govt. Policy and technological change	2.07	II	2.25	V	
3	Creation of market demand	2.06	III	3.50	II	
4	Preference of consumers	2.13	I	5.00	I	
5	Possible conflict in adoption of sustainability measures	2.04	IV	2.75	III	
6.	Scope for disaster management	2.01	V	2.50	IV	

Analysis pertaining to the table above reveals a non-significant result. In other words both the groups agree for the enlisted sub-components under adaptability. However, the final ranking of sub-components under respective measures are taken into consideration for both the groups of samples as shown in table.

Taking both sample farmers and judges together the relative position of subcomponents under ecological soundness are soil, water, type of farming, nutrient status, use of organic manure and use of bio-pesticides and fungicides.

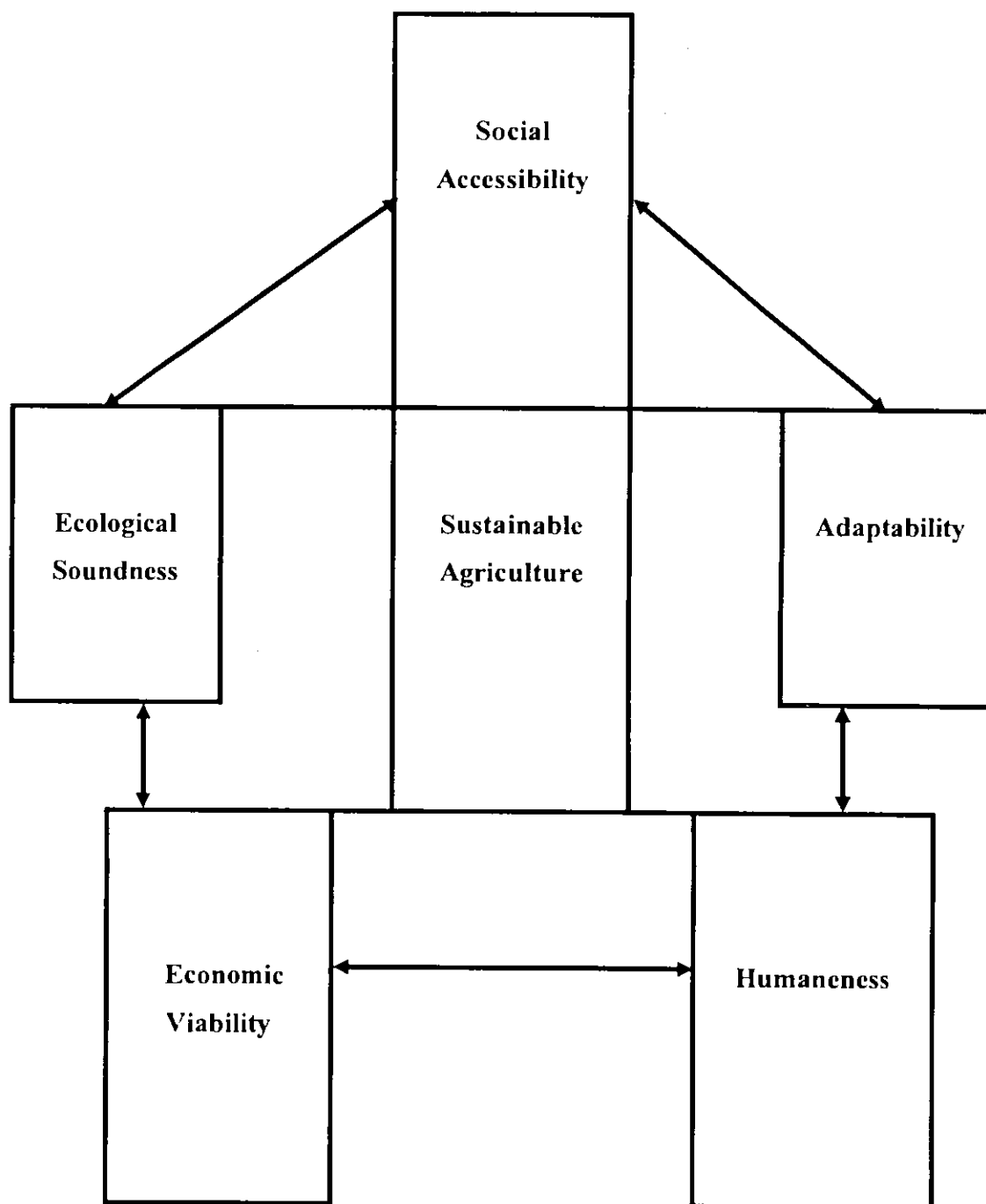
Economic viability leading to sustainability of agriculture emphasized the components of profitability, adequate income, production level, resource conservation, profitable crop husbandry and profitable animal husbandry.

Social accessibility considered relative position of subcomponents as market opportunity, common access to village resources, participatory decision making, use of energy, availability of capital and technological support.

Under humaneness the preferred subcomponents in order are found to be respect for honorable living, feeling for others, social solidarity, cordial relationship, honorable living and climate of trust worthiness.

Adaptability measures to have sustainability in agriculture considered consumer preference, accommodation for change in agriculture, creation for market demand, conflict owing to adoption, scope for disaster management and accommodation for Govt. policy in order.

Figure 8 : Factors of Sustainability of Agriculture



Correlation matrix:

Further attempt was made to find out correlation matrix of major variables under study. The matrix is given in table below.

Table 61: Correlation matrix of the variables of Sustainability of Agriculture

Variables	ES	EV	SoA	H	Ad
ES	—				
EV	0.2872*	—			
SoA	0.0459	0.375*	—		
H	0.1837	0.6897**	0.0138	—	
Ad	0.2657*	0.5777*	0.0699	0.7476**	—

* : Significant at 5% level of probability

** : Significant at 1% level of probability

Where,

ES : Ecological Soundness

EV : Economic Viability

SoA : Social Accessibility

H : Humaneness

Ad : Adaptability

Ecological soundness was found to be closely associated with Economic viability and adaptability of recommendations to maintain sustainability of agriculture. Economic viability equally was associated with three important variables namely, Social accessibility, Humaneness and adaptability of recommendations. On the other hand Social accessibility was found to be independent of Humaneness and adaptability. Humaneness and adaptability were found to be highly correlated at 1% level of probability. The analysis led to infer that ecological soundness, Economic viability and Adaptability are important variables to determine the sustainability of locality so far agriculture is concerned.

OBJECTIVE – V

ADOPTION OF RECOMMENDED MEASURES OF SUSTAINABLE AGRICULTURE

Conservation of natural resources essentially means maintenance and improvement of ecological status and not permitting them for further degradation. The natural resources are soil, water, forest, mountain and animal resources. An attempt was made to find out whether the respondents adopt certain recommendations for preservation of these natural resources irrespective of source of advice.

5.1. Soil health:

Soil is considered as an important ingredient of ecological soundness of an area. Adoption of soil health measures, like adding of organic manures, following of crop rotations, use of balanced chemical fertilisers, green manuring and bio-fertilisers are some of the recommendations to maintain soil health. While examining the adoption of these measures, the following results were obtained.

Table 62: Adoption of soil health measures.

Sl. No	Soil health measures	Adoption	
		Frequency	Percentage
1	Use of organic manures like compost, FYM etc.	61	30.50
2	Crop rotation	130	65.00
3	Balance use of chemical fertiliser	0	0
4	Green manuring	80	40.00
5	Bio-fertilisers	81	40.50

The percentage analysis of data presented revealed that the sample under study are adopting crop rotation (65%) followed by use of bio-fertilisers (40.5%), green manuring (40%) and organic manures to retain health of their soil. However, it is surprising that none of the farmers test soil and then apply chemical fertilisers in

balanced dose. The use of organic matter in soil particularly was observed to be age old practice with the sample.

5.2. Water

Orissa suffer from erratic rainfall almost every year. The recommendations are given to the farmers to preserve run-off water and to make optimum use of water to raise the crops. Adoption of recommendations with regard to water use technology was examined as given in the table below.

Table 63: Adoption of Water conservation measures

Sl. No	Ingredients of Water conservation measures	Adoption	
		Frequency	Percentage
1	Check run-off of water through small and medium water reservoirs	72	36.00
2	Raising of vegetations	160	80.00
3	Creation of irrigation facilities	143	71.50
4	Water harvesting structures (in situ water management)	73	36.50

A look at the table reveals that the farmers in the area of study are much more acquainted with growing of vegetation (80%) followed by creation of small irrigation facility (71.5%) and checking run-off of water (36%). However, water harvesting structures is found to be adopted by 36.5% of the sample. The farmers are conscious about preservation of rain water in the small water reservoirs, like tanks and ponds. From time immemorial, some tanks and small water reservoirs were created to arrest run-off water which are in bad conditions.

5.3. Bio-control methods

In recent years there has been consciousness among the farmer to take up bio-control methods for preserving ecological soundness. It was observed that out of 100

small farmers 57.5% have adopted bio-pesticides and bio-fertilisers to replace chemical pesticides which add preserve to ecological entity of the area.

Adoption of conservation measures in respect of soil, water, forest and animal are summarized in table given below.

Table 64: Adoption of Preservation of natural resources

Sl. No	Elements of Natural resource	D1		D2		D3		D4		Total	
		f	%	f	%	f	%	f	%	f	%
1	Soil	18	36.00	19	38.00	31	62.00	22	44.00	90	45.00
2	Water	19	38.00	18	36.00	24	48.00	22	44.00	83	41.50
3	Forest & Mountain	--	--	--	--	38	76.00	--	--	38	19.00
4	Animal wealth	25	50.00	22	44.00	25	50.00	25	50.00	111	55.50

Further, making comparison of adoption of conservation methods between districts, the results were obtained as contained in table below.

Table 65: Difference among the districts in the preservation of natural resources

Sl. No.	Elements	D1 X D2	D1 X D3	D1 X D4	D2 X D3	D2 X D4	D3 X D4
1	Soil	0.207	2.601*	0.816	2.40*	0.610	1.803
2	Water	0.207	1.01	0.610	1.22	0.816	0.803
3	Forest & Mountain	--					
4	Animal wealth	0.601	2.92*	0	3.485*	0.601	2.92*

* Significant at 0.05 level

Where, **D1** : Puri **D2** : Khurda **D3** : Ganjam **D4** : Balasore

The result in table 65 reveals that preservation of animal is found to be maximum followed by soil and water. This is so because; the introduction of cross breed or up-gradation of local breed has not been taken up extensively. People have preference for local breeds especially in case of cows for the reasons of maintenance, free from diseases

and feed consumption. However, absence of forest and mountain in the area under respective districts did not intend the farmers to adopt measures covering these. However, the statistical information as per District statistics handbook, Govt. of Orissa (2003) reveals that forest area of the districts of Balasore, Khurda, Puri and Ganjam is reported to be 0.57%, 1.064%, 0.235% and 5.41% respectively.

5.4. Economic Viability

The economic viability is the composite outcome of different measures adopted by the farmers to increase the yield and thereby profit. The following table reveals the adoption of productive ingredients in the area under study to increase profitability of farming.

Table 66 : Adoption of ingredients of Productivity of farm

Sl. No	Production Ingredients	Adoption	
		Frequency	Percentage
1	HYV Seeds	200	100.00
2	Balance use of fertilizers	0	0
3	Irrigation management practices	120	60.00
4	Post harvest technology	79	39.50
5	Use of low cost inputs like Bio-fertilisers/ organic manures to replace chemical fertilisers	61	30.50
6	INM and IPM practices	0	0

A look at the table reveals that use of HYV seed is found to be extensively used by respondents under study, where as irrigation management practices as recommended are adopted by 60%, post harvest technology by 39.5% and bio-fertilizer by 40.50% of the sample. However, no response was recorded with regard to use of balanced chemical fertilizer and adoption of INM and IPM practices. The practices of INM and IPM have yet to be popular with the farmers.

5.5. Profitable Crop-husbandry

Sustainability in agriculture ultimately aims at profitability of present farming systems without endangering the future. In finding out the measures adopted to increase the profitability of Crop-husbandry the following results were obtained.

Table 67: Adoption of profitable measures in Crop-husbandry

SL. No	Components of profitability	Adoption	
		Frequency	Percentage
1	Adoption of package of practices	89	44.5
2	Use of latest information in farming	99	49.5
3	Contact with marketing network	112	51.00
4	Value addition	85	42.5
5	Emphasis for consumer- preference	75	37.5

A look at the table reveals that there is increasing trend among the farmers to establish contact with the market and make use of latest information in farming followed by adoption of improved package of practices and making value addition to fetch more price in market. However, 37.5% of sample found to have interest to grow crops keeping consumer preference in view. The trend reveals that farmers are gradually becoming interested in commercializing farm produce in the area under study.

5.6. Profitable Animal Husbandry :

Livestock continued to be supporting source of income for the farm families in rural areas of Orissa. With rising of consciousness for better living, a diversification in occupation is observed. The livestock is found to be most acceptable enterprise for the farmers even at micro level to increase income level. The information collected regarding efforts made by sample farmers to increase the profitability in animal husbandry following information was received.

Table 68: Adoption of recommendations leading to profitability of Animal Husbandry

SL. No	Components of profitability in Animal Husbandry	Adoption	
		Frequency	Percentage
1	Quality breed	109	54.50
2	Use of balance feeds	55	27.50
3	Raising of fodder	48	24.00
4	Health cares practices	48	24.00
5	Use of technical information	47	23.50
6	Value addition	76	38.00
7	Market link	79	39.50

Analysis contained in table above reflects that the farmer in area under study are relatively more conscious in adopting quality breed (54.5%), establishing linkage with market due to operation of OMFED (39.5%) and value addition (38.0%) followed by use of fodder and health care practices (24.0%). Use of technical information was found to the extent of 23.5%. The study shows that components leading to profitability to animal husbandry have been adopted by the sample to a level of satisfaction.

5.7. Social accessibility

Social Accessibility is another aspect of sustainability in agriculture. In examining the aspect of study in terms of equal access to common resources, use of energy, provision of adequate technological support, availability of capital to operate the occupation and prevalence of participatory decision making for common use, the following results have been obtained.

Table 69: Elements of Social Accessibility

SL. No		Present		Not present	
		Frequency	%	Frequency	%
1	Equal access to common resources	101	50.50	99	49.50
2	Use of energy in farming	109	54.50	91	45.50
3	Technological support to all	100	50.00	100	50.00
4	Easy availability of credit to all	97	48.50	103	51.50
5	Community decision to adopt new technology	96	48.00	104	52.00
6	Equal market opportunity to all	100	50.00	100	50.00

Results reveal that the prevailing situation in case of community decision making, easy availability of capital in farming, equal marketing facility and easy access to common resources in the villages are at discouraging rate.

5.8. Humaneness:

Human value and honorable living are interactive factors in deciding worth of living in society. Sustainability in agriculture aims at providing these human values to the practitioners. While examining the humaneness in the term of respect for honesty, good relationship, respect for honorable living, climate for trustworthiness, feeling for others and social solidarity, the following results were obtained.

Table 70 : Elements of Humaneness

SL. No	Elements of Humaneness	Present		Not present	
		Frequency	%	Frequency	%
1	Respect for honesty in society	89	44.50	111	55.50
2	Good relationship among the communities	88	44.00	112	56.00
3	Respect for honorable living	87	43.50	113	56.50
4	Climate of trust worthiness	94	47.00	106	53.00
5	Feelings for others	78	39.00	122	61.00
6	Social solidarity	95	47.50	105	52.50

The results contained in the table show that elements of humaneness, which constitute our social value system, are not in desirable manner. Almost all the elements are found less than 50% than the expectations. Feeling for others, respect for honourable living, cordial relationship among the communities need a good deal of effort to add to sustainability. These indirect factors have much more influence on sustainable agriculture index (SAI) because agriculture is an enterprise of human values in our society.

5.9. Adaptability:

Adaptability is a measure of accommodation assimilation and integration of new technology into social system. Proneness to accommodate changes in agriculture, Govt. policy, changing market situation, consumer preference, conflict to adopt and technique of disaster management were studied as revealed in the following table.

Table 71 : Elements of Adaptability

SL. No	Elements of Adaptability	Acceptable		Not acceptable	
		Frequency	%	Frequency	%
1	Technological change in agriculture	106	53.00	94	47.00
2	Market demand	103	51.50	97	48.50
3	Consumers' preference	99	49.50	101	50.50
4	Conflicts in adoption of sustainable measures	79	39.50	121	60.50
5	Disaster management	59	29.50	141	70.50

Analysis of the table infers that Govt. policy and technological change in agriculture are accepted by the people for making quality livelihood. Adaptability to the changes in market demand, preference to consumer and avoiding conflict in adoption are found to be in order indicating the reaction of the people. In sustainability providing

scope for disaster management was responded by 29.5% of the sample. On the whole the table depicted that there is increasing trend among the people to accommodate adaptability of sustainability measures.

Summarizing the findings on adoption of different sub-components of sustainability of agriculture, the following results were obtained.

Table 72: Adoption and preference for sub-components of sustainability in agriculture

Sl. No.	Sub-components of Sustainable Agriculture	Average %
1	Ecological soundness	45.60
2	Economic viability	41.70
3	Profitable crop husbandry	41.33
4	Profitable animal husbandry	33.00
5	Social accessibility	50.25
6	Humaneness	44.33
7	Adaptability	46.17

A look at the table reveals that adoption of social accessibility, adaptability, ecological soundness, humaneness, economic viability, profitability of crop husbandry and profitable animal husbandry are found to be in order.

OBJECTIVE – VI

EXTENSION APPROACH FOR ENHANCING SUSTAINABILITY IN AGRICULTURE

Transfer of technology is closely associated with generation of technology and its use leading to development. Extension components contain stimulating inputs that would mobilize the practitioners to put recommendations into action. Sustainability in agriculture is very important component of present day agriculture and future aspirations. Keeping these aspects in view an attempt was made to enlist suggestions under extension approaches that would enhance sustainability in agriculture in the area under study. The suggestive extension measures to enhance sustainability in agriculture were studied under components of social structure, cooperation mechanism, evaluation technique and marketing network.

6.1. Social structure and organisation:

To initiate action in the social system there is need to intervene the social structure and a structural set up is to be devised to put recommendations into action. Sustainability in agriculture needs community approach and initiative. While examining the possible social structure either existing or can be developed to maintain Sustainability in agriculture the following results were obtained.

Table 73: Suggestive social structure in order of importance

Sl. No.	Dimensions	Rank
1	Committee with specific regulations	I
2	Local organisations and NGO	II
3	Government's line Departments	III
4	Youth association	IV
5	Women forum	V
6	Agri-business / traders	VI
7	Agri-clinic	VII
8	Local credit institutions	VIII
9	Involvement of ATMA	IX
10	Others interested in preservation of eco-system	X

The above ten important social structures can be utilized to infuse idea of sustainability of agriculture among the small farmers and insist upon for follow up.

6.2. Cooperation mechanism:

In rural Orissa there are many organizations and institutions which start operating but closed down after sometime owing to reasons of many factors like lack of leadership, lack of resources and absence of remunerative development programmes. Attempt was made to find out as to what kind of co-operative mechanism necessary to sustain the sustainability of agriculture.

Table 74: Cooperation mechanism for sustainability of agriculture in order of importance

Sl. No.	Dimensions	Rank
1	Regular meeting of sustainable committee	I
2	Inviting experts for technical support	II
3	Organisation of training on sustainability of agriculture	III
4	Field visit of developed area of sustainability of agriculture	IV
5	Fixing achievable objectives	V
6	Developing a plan of action	VI
7	Incorporation of Govt. Policy	VII
8	Contact with outside agency for suggestion	VIII
9	To establish linkage with development department	IX
10	Encouraging farmers to offer innovative ideas	X

Above suggested mechanisms seem to be logical and sound as it involves local people to the maximum extent to work towards sustainability of agriculture. Inviting experts from outside, training, field trip, linkage with development departments and working on innovative ideas of farmers can show better path on how to maintain sustainability. However, establishment of achievable objective and developing sound action plan will bring success to preserve eco-system.

6.3. Evaluation technique:

Evaluation is an integrated and important component of any programme to be undertaken. The community approach to have sustainability in agriculture through social structure and mechanism need evaluation to indicate movement in right or wrong direction. The evaluation of action for sustainability in agriculture as suggested by the sample is recorded in table below.

Table 75: Evaluation of action for sustainability of agriculture in order of importance

Sl. No.	Dimensions	Rank
1	Periodical visit of experts and their opinion	I
2	Analysis of situation	II
3	Evaluating level of production and productivity	III
4	Assessment of changes in socio-economic status	IV
5	Assessment of progress as per plan of work at regular interval	V
6	Modification in programme on the basis of feed back	VI
7	Documentation of reasons for failure and success	VII
8	Re-fixing of priority	VIII
9	Assessment of extent of people's participation	IX
10	Study of reaction of people in general	X

The above suggestions are logical and appropriate so far in the area under study is concerned. The periodical visit of experts and offering opinion, level of increase in production and productivity and status of living are the real indicators of sustainability in agriculture as these are related to ecological soundness, economic viability, social accessibility, humaneness and adaptability.

The above evaluating process if followed regularly the author feels the sustainability can be maintained in the field of agriculture.

6.4. Marketing network:

At present day business like agriculture can hardly be thought or without market network. As has been reported in various studies that marketing is positively correlated with production level. The study realizing the importance of market suggestions were sought for networking of marketing at micro-level.

Table 76 : Marketing network for sustainability of agriculture in order of importance

Sl. No.	Dimensions	Rank
1	Price fixation by local committee	I
2	Opening of Krushak bazaar	II
3	Purchase of farm produce by Govt. agencies	III
4	Facility for storage and disposal	IV
5	Price on the basis of value addition	V
6	Display of price rate of different commodities	VI
7	Change in fixing price policy	VII
8	Creating facility for grading and packaging	VIII
9	Use of market information	IX
10	Initiation of Regulatory market system	X

The above suggestions were received to make marketing net work stronger to help the small farm operators to strengthen their interest level leading to sustainability.

OBJECTIVE – VII

SUGGESTIONS AND STRATEGY

The present investigation “The factors affecting sustainability of agriculture under small farm production system in coastal ecosystem of Orissa” was undertaken to ascertain the status of ecological factors and suggest means and ways to improve the situation. The response of the sample farmers and the findings of the study together led to suggest the following measures for up gradation of ecosystem of the coastal area leading to sustainability of agriculture. Like other states, Orissa is also facing with problems of sustainability of agriculture. Our sample districts namely Puri, Khurda, Ganjam and Balasore which are situated in coastal eco-system of the state has different problems concerning to natural resources like soil, water, forest and animal wealth.

The suggestions to improve the sustainability status of agriculture have been viewed from two important angles. One is adoption of technological measures to preserve natural resources and other is the policy and extension approach to educate people about the necessity of taking such measures to sustain for sustainability of agriculture and improve upon.

7.1. Adoption of Technological measures

Technological measures concerning to soil, water, forest and animal wealth have been advocated by the concerned departments of the state and national Govt. which have equal applicability under specific agro-climatic zone.

i. Soil status

The districts under study namely Puri, Khurda, Ganjam and Balasore cover about 11.76% of total geographical area of the state. The cultivable area of these four districts is 96,05,574 ha. The cropping intensity of these districts is 163.5% and the cropping pattern is mainly rice-pulse, rice-oilseeds, rice-vegetables and rice-fallow. The soils of

these districts are not responding to as previously without use of chemical fertilizers and even to some extent over the recommended doses.

The farmers are in view that following treatments may be taken up to upkeep the soil health and with gradual removal of chemical fertilizers. The suggestions to improve soil condition are given below.

Table 77: Suggestions to improve soil condition

Sl. No.	Suggestions to improve soil condition	Rank
1	Use of FYM, Green manure and Compost	I
2	Inclusion of legumes in rice based cropping system	II
3	Gradual replacement of chemical fertilizers	III
4	Avoiding over grazing in summer	IV
5	Efficient use of the irrigation water	VI
6	Use of bio-fertilisers	V
7	Fertiliser use on the basis of soil test	VII

The above suggestions are general in nature. The farmers are not aware of other packages. They insist on use of FYM and compost, which were the practices over past generations to keep soil rich. But after use of chemical fertilizers the status of soil has been changed. The farmers are in opinion that present soils of their fields do not respond as earlier. The suggestions further revealed that emphasis on use of FYM, green manure as well as supply of seeds of green manuring crop; inclusion of pulse in crop rotation should be encouraged to reduce dependency on chemical fertilizers. The summer grazing and water management practices in irrigated area need a great deal of planning to restore the fertility level of soil. The last suggestion, use of fertilizer on soil test also is genuine to prevent imbalance use of chemical fertilizer.

ii. Water

The coastal belt of Orissa enjoy the opportunity of irrigation water besides there is need to arrest run off water through different water reservoirs for future use in farming and increasing water table of the area. The observed position of ground water table is not encouraging. The small farm holders offered the following suggestions to preserve water for use in agriculture in summer and incase of scarcity of rainfall.

Table 78: Suggestions to preserve water

Sl. No.	Suggestions to preserve water	Rank
1	Conservation of run-off water in small ponds/tanks	I
2	Recharging of ground water through contour bunding and terracing	II
3	Use of sprinkler and drip irrigation	III
4	Consumptive use of multi-source and multi-quality water	IV
5	Adoption of recommended irrigation practices	V

The above suggestions are scientific recommendations to conserve water in the areas of investigation. The farmers of surveyed area feel that run-off water could be conserved erecting field bunds wherever possible. There are chemical based industries, which discharge chemicals to the rivers that is to be checked. To preserve water for scare days, use of sprinkler and drip irrigation is the answer as suggested by the respondents.

iii. Forest

The forest area of the state is about 37.33% and the surveyed districts possess 11.74% of area under different kinds of forest. As per rule of the State Govt., steps are taken to restore the forest area. The sample farmers have suggested the following measures to restore the forest area within the locality.

Table 79: Suggestions to improve forest area

Sl. No.	Suggestions to preserve forest area	Rank
1	Raising of forest	I
2	Planting of trees in the vacant areas	II
3	Prevention of forest fire	III
4	Planting of non-timber forest trees	IV
5	Raising of nursery for multipurpose tree species	V
6	Preservation of forest through local committee	VI
7	Adoption of participatory forest management system	VII
8	Heavy penalty for offenders	VIII

The findings revealed that the respondents of the study area are conscious of the forest resources. They emphasized that community participation to manage the forest is of prime importance. There is need to create sensation among people about the forest. Raising of non-timber forest is another solution to reduce pressure on forest to meet the requirements of fuel and fodder of the people.

iv. Animal wealth

Animal wealth is an integral part of farming system. Orissa represents 9.16% to the national animal wealth. The surveyed districts have cattle population upto 19.25% of the state. The suggestions of the sample to preserve animal wealth were recorded as mentioned below.

Table 80: Suggestions to preserve animal wealth

Sl. No.	Suggestions to preserve animal wealth	Rank
1	Preserving indigenous germplasm	I
2	Improvement of local breed	II
3	Fodder cultivation	III
4	Animal feed of local available feed materials	IV
5	Regular animal health check-up	V

The suggestions contained in table above reveal emphasis on local indigenous breed, fodder cultivation and preparation of animal feeds on locally available materials.

7.2. Policy and extension approach

i. Profitable enterprise

The objective of sustainability of agriculture is not only to preserve ecosystem but also to provide higher income to sustain the farm and farming enterprise. This in turn will reduce manipulation of natural resource in development process. There have been a number of suggestions regarding profitability of agri-enterprise to supplement the concept of sustainability. The suggestions have been presented below.

Table 81: Suggestions regarding profitable farming enterprise

Sl. No.	Suggestions regarding profitable farming enterprise	Rank
1	Diversified farming system	I
2	Production as per consumer preference	III
3	Value addition to farm products	IV
4	Market link	II
5	Adoption of cost effective technology	VII
6	Provision of agro-service centers	VI
7	Emphasis on use of renewable energy	VIII
8	Training for capacity building	V
9	Priority of benefit to poor	X
10	Women empowerment	IX
11	Timely dissemination of farm technology	XIII
12	Involvement of SHGs	XI
13	Technology support at doorstep	XII
14	Importance on participatory decision making	XVII
15	Involvement of micro-level institutions and organizations/ NGOs	XIV
16	Development of local leadership	XV
17	Operation of village committee for sustainable agriculture	XVI
18	Partnership between public and private agencies	XXIII
19	Use of graded technology	XVIII
20	Alertness to disaster management	XXI

Sl. No.	Suggestions regarding profitable farming enterprise	Rank
21	Provision of seed bank, community nursery and fodder production	XIX
22	Emphasis on honesty and integrity	XX
23	Working with common consciousness	XXII

Further the extension components in maintaining sustainability in agriculture is to be given due importance to bridge gap between farmers, and Subject Matter Specialists (SMS) and scientists. To initiate the concept of sustainability and motivate the small farm operators in particular, a new approach in extension system is necessary. Out of the findings of the study, the following measures are suggested to strengthen the extension system to work towards sustainability of agriculture.

Table 82: Suggestions to strengthen extension system

Sl. No.	Suggestions to strengthen the extension system	Rank
1	Organisation of sustainable committee at village level	I
2	Regular functioning of committee	II
3	Inviting experts for technological support	III
4	Co-ordinating the line departments	IV
5	Contact with outside agencies for suggestion and technical help	V
6	Encouraging indigenous technical knowledge (ITK) and innovative ideas	VI
7	Following the procedure of proper planning	VII
8	Regular evaluation in the progress of the sustainable activities.	VIII
9	Encouraging innovative ideas	IX

The suggestions contained in above table like, organisation of sustainable committee on agriculture, regular functioning of committee and visit of experts on technological matters in suitable intervals would able to bring sustainability in agriculture. The other factors like, co-ordination with line departments, contact with outside agencies, use of ITK, proper planning, evaluation and inclusion of new ideas would help to achieve sustainability in agriculture to a great extent.

Chapter - VI

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The study entitled “Factors affecting sustainability of agriculture in small farm production system in coastal ecosystem of Orissa” was conceived out of consideration of continuous degradation of natural resources consisting of soil, water, forest and animal wealth of the state. With broad objective of investigation into the status of sustainability of agriculture in the state, the specific analysis like socio-economic and farming related situations, perception about sustainability of agriculture in terms of ecological soundness, economic viability, social accessibility, humaneness and adaptability, development of sustainable agriculture index, adoption of sustainable measures, extension components and suggestions and strategy to maintain sustainability were taken into consideration.

The study was conducted in the state of Orissa covering the districts of Puri, Khurda, Ganjam and Balasore. Altogether four blocks each of one district and eight villages two from each block were selected for the purpose of the study. As much 200 respondents who were within definition of small and marginal farmers were selected for interview. The respondents randomly so selected were personally interviewed by the author through an interview schedule developed on the basis of objectives stated earlier. The secured data were processed statistically to reveal the relevant findings as per the need of the study. The relevant findings of the study have been summarized below.

1. The socio-economic and farming related variables included in the study were personal, social, economic, communication, marketing behaviour, farming behaviour and training. Altogether 24 variables were taken into considerations while analyzing socio-economic and farming related variables.
2. The level of perception of respondents were classified into low, medium and high group. The differential observation covering the three groups were put under different tests.
3. Of the sample maximum were within age group of 41 to 50 years and above which confirms that respondents were matured enough to understand and respond to questions of sustainability of agriculture.
4. Out of five levels of education, maximum respondents were located in the educational level of primary and M.E. School. However, 5.5% of them were illiterate. The level of education was found to be associated with perception of sustainability of agriculture of respondents.
5. Family composition revealed as much as 86.5% had the family size of more than 4 persons where 13.5% had family composition upto 4 members only.
6. The sample respondents had joint family system upto 47% against 53% who had nucleus type of family.
7. Of the sample, 12% belonged to SC, 41% OBC and 47% to other groups where as none belong to ST group.
8. Findings revealed, of the sample 20% had no membership whereas 47% had with 3 to 4 and 33% upto 2 organizations. Membership in formal organizations and perception level were found to be related significantly.

9. The economic factors included variables like land holding, occupation, area under irrigation, crops grown, animal wealth, additional source of income, use of energy and farm machinery. The land holding of the respondents was found to be not significantly associated with level of perception and similar trend was also observed in case of occupation of the respondents. The occupation of the sample was farming upto 87% whereas service and business with 8.5% and 4.5% of the sample respectively.
10. The farmers under study normally grow two different crops (75%) followed by mono-cropping (15.5%) and three different crops (10.5%). Perception level and number of crops grown was found to be independent of each other.
11. Animal wealth of the sample revealed that as high as 69.5% possessed more than 4 animals and 30.5% have less than 4 animals. The possession of animal wealth and perception level was found to be non-significant.
12. The sample under study depend on livestock and fishery for additional income. However, source of additional income was not found to be significantly associated with the level of perception.
13. It is interesting to note that about 75.5% of the sample did not use any kind of energy in farm operation and only 24.5% who did. Use of energy and perception level was found to be significantly associated.
14. The findings revealed that of the sample 58.5% possessed sprayer, 17% winnower, 9% power tiller, 3% tractor whereas 83% had mould board plough.

15. Role of mass media in transfer of technology needs no emphasis. The study revealed that as high as 92% are exposed to mass media carrying agricultural information as against 8% who did not avail such opportunity. The Chi square value being significant mass media is found to be positively associated with formation of perception about sustainability of agriculture.
16. It is observed that farming experience and responsibilities at farm level are almost same with all the respondents under study. Since all the farmers take farming as occupation and are involved directly in farming process, farming experience and responsibilities could not be identified as parameters of study.
17. As per the findings, majority of the sample (80.5%) had availed training facilities against 19.5% who did not. The frequency of training is more pronounced at high level of perception followed by medium and low level. Further, the training and perception level were found to be interrelated.
18. Of the sample, as much as 80% had farm produce little surplus over family requirement, 10.5% had produced just manageable and only 9.5% had marketable surplus i.e., more than family requirement who sell their produce in the market. However, due to more or less homogeneity of the sample in land holding, the marketable surplus and perception level was found to be independent of each other.
19. Considering the sale price of farm produce, it is interesting to note that more than half of the sample (54.5%) expressed farm produce as not to be remunerative whereas 25.5% opined it to be remunerative at times and only 11.5% expressed the farm produce to be quite remunerative. The findings also confirmed a significant relationship between perception level and opinion on sale price.

20. It is revealed that as much as 59% of the respondents sell their farm produce outside the locality followed by 37.5% who sell in their locality only. However, a few of the sample (3.5%) could establish market link outside the district.
21. Variation in profile of samples of the districts under study revealed that maximum difference was observed in case of age (49.2%), exposure to mass media (8.75%), family occupation (6.17%) and caste structure (3.35%). However, all four districts being situated in coastal tract, the other factors remained homogenous in nature.
22. Perception of small farm operators about sustainability of agriculture was investigated under the important factors of ecological soundness, economic viability, social accessibility, humaneness and adaptability. Of these factors, economic viability was ranked first followed by ecological soundness, social accessibility, adaptability and humaneness as important contributing factors towards sustainability of agriculture in order of merit.
23. Ecological soundness was perceived in terms of use of organic fertilizers, bio-pesticides, organic content of soil, crop rotation, maintenance of nutrients in soil and availability of ground water in order.
24. To have economic viability of the present farming system the reaction of the sample rated level of production and stability, conservation of natural resources, increase in profitability, remunerativeness, use of cost effective technology and livelihood management system consisting of animal component in order of preference.

25. Social accessibility as factor of sustainability counts much towards equitable accessibility to village resources, use of energy in agriculture, availability of capital at local level, marketing of farm produce, participatory decision making and adequate technical support in order of mention.
26. Humaneness is an important factor of sustainability of agriculture. The reaction of sample rated respect for honesty and value system, cordial relationship, climate of trust worthiness, social solidarity, respect for honorable living and opportunity for compassion as the major elements to have humaneness within the framework of sustainability.
27. Adaptability of the technology decides the magnitude of sustainability of agriculture. Progressiveness, accommodation of Govt. policy, consumer preference, scope for disaster management, undivided market are the attributers of sustainability so far adoption of technology is concerned.
28. The findings revealed considerable gap (32.7%) in the perception of the sample against factors of sustainability like ecological soundness, economic viability, social accessibility, humaneness and adaptability. However, it is interesting to note that the gap in all the cases were almost equal.
29. A significant correlation was observed in between perception of the sample and factors of sustainability, whereas comparatively more closeness was observed in case of high level of perception over low and medium. Further, the relative contribution of factors towards sustainability was found to be highest in case of humaneness followed by ecological soundness, social accessibility, economic viability and adaptability. However, the sample realized the importance of value system over the technological factors.

30. The study was conducted in eight villages of four districts of Puri, Khurda, Ganjam and Balasore. In the parameter of study, the village Bantalasingh, Sampur, Makarjhol and Baunsamukha had better ecological soundness over other villages.
31. In the scale of economic viability, Aruha, Bantalsingh, Sadanandapur and Baunsamukha were found to be at better position than other villages. Equally in the matter of social accessibility some villages like Rajasa, Sampur, Makarjhol and Baunsamukha had better position than the others. Similarly, in the matter of humaneness, Aruha, Alasi, Sadanandapur and Baunsamukha were found to be in better than other villages. In the term of adaptability, Aruha, Rajasa, Sampur, Makarjhol and Sadananandapur rated higher than other villages.
32. Of the villages studied, Aruha, Rajasa, Alasi, Makarjhol and Sadanandapur had higher sustainable agriculture index (SAI) over the other villages under study. However, factors of sustainability and districts fail to establish significant relationship so far as SAI is concerned in the area under study.
33. The subcomponents of factors of sustainability of agriculture were investigated in depth. The study revealed that (a) soil, water and nutrient of ecological soundness, (b) profitability, adequate income and production level of economic viability, (c) market opportunity, accessibility to village resources and participatory decision making of social accessibility, (d) honourable living, cordial relationship and social solidarity of humaneness and (e) preference of consumers, accommodation for social change, creation of market demand and possible conflict in adoption of sustainability measures were the top ranking sub-components in connection with the sustainability of agriculture.

34. Economic viability verses ecological soundness, social accessibility verses economic viability, humaneness verses economic viability and adaptability verses ecological soundness, economic viability and humaneness were found to be significantly related under correlation matrix.
35. Adoption of recommended measures of sustainability of agriculture is the ultimate goal of various efforts towards sustainability. The study has attempted to find out adoption of recommendations under different situations.
36. Crop rotation, green manuring, organic manures were adopted by 65%, 40% and 30.5% respectively.
37. For conservation of water the adoption of measures is recorded upto 80% in case of growing of vegetation followed by creation of irrigation facilities (71.5%), water harvesting structures (36.5%) and checking run-off water (36%).
38. Bio-control measures to preserve natural resources are found to be very satisfactory. Preserving soil, water and animal wealth, the sample have good adoption percentage. Comparing the four districts the difference is found to be significant for soil conservation measures between Puri and Ganjam, Khurda and Ganjam and animal wealth between Ganjam and Balasore followed by Khurda and Ganjam.
39. The findings of the study revealed that to satisfy the requirements of sustainability, the elements of Social Accessibility is to be taken care of through use of elasticity in agriculture by farmers, providing equal access to common village resources, providing technical support to all the farmers, ensuring equal market opportunity to small farmers and emphasis on community decision to adopt new technology in the area.

40. The respondents are in opinion that to make agriculture sustainable, it is also necessary to create a climate of trustworthiness, social solidarity, respect for honesty in society, cordial relationship, among all community and sense of feeling for others.
41. Adoption of technological measures for sustainable agriculture need to indicate feeling of people for accepting technological change in agricultural operation with Govt. policy, meeting changing market demand and responding to consumer preference for sale of their produce. Equally action for discontinuity management and to avoid conflict in view of adoption of sustainable measures are to be taken care of.
42. Summarising all the important sub-components of sustainability of agriculture, it was observed that all the six components are of equal magnitude ranging from 33.50% to 50.25%.
43. The present study carried out in coastal area of Orissa yielded suggestions and strategy for upkeeping the status of agriculture in the state. The strategy has been presented under two important sections mainly technological measures and policy with extension approach. The technological measures are soil, water, forest and animal wealth.
44. To improve the soil condition of the area of study the suggestions included use of FYM, Green manuring, compost, inclusion of legumes in rice based cropping system, gradual replacement of chemical fertilizers, limiting over grazing of cattle in summer, care of bio-fertilizer, efficient use of irrigation water and fertilizer on the basis of soil test. The suggestions have been ranked as per mention of the sample.

45. To preserve water for the purpose of agriculture and other uses the suggestions in order of merit were conservation of runoff water in small ponds and tanks, recharging ground water through contour bunding and terracing, use of sprinkler and drop irrigation on the basis of applicability, making consumptive use of water and adopting recommended procedures in irrigation for crop production.
46. Although forest area of the surveyed district is comparatively small to inland districts of the state, there is need to preserve and extend the forest area. The important suggestions include raising of forest on available land, planting trees in vacant places, prevention of forest fire, planting of non-timber forest trees to reduce pressure in forest and activating local communities to preserve forest through participatory approach and heavy penalty for offenders.
47. For preservation of animal wealth the people were in opinion that there is need for preserving indigenous germplasm, improving local breed, extending fodder cultivation manufacturing animal feed from locally available feed materials along with regular animal health checkup practices.
48. Policy and extension approach include means and ways to increase profitability of animal enterprise and adoption of extension methods for sensitizing rural people to work towards sustainable agriculture.
49. For making farming profitable and side by side maintaining sustainability, the suggestions include diversified farming system, market link, making production as per consumer preference and making value addition of the product. The other suggestions included are providing training for capacity building, providing agro-service centers, upgrading cost effective technology and emphasizing on use of renewable energy.

50. The study emphasized that to make agriculture sustainable attention should be paid to empower women, giving priority to poor people, involving SHGs at ground level, programmes supported with providing technology at doorstep.
51. The other important suggestions include, timely dissemination of farm technology (IT), involvement of NGOs, developing local leadership, operation of village committee, selection of graded technology for farmers and emphasizing participatory decision making process.
52. Further suggestion like provision of seed bank, emphasis on honesty and integrity in community work, making people alert about disaster management and creating atmosphere to work with common consciousness. The study strongly believes that partnership between public and private agencies is to be developed to take care of agriculture and sustainability measures.
53. The extension approach in the area need to be redesigned for making agricultural sustainability. The suggestions include organisation of sustainable committee at village level with regular operation of committee, inviting experts for technological support and coordinating line departments for suggestions and inputs. However, suggestions also included keeping contact with outside agencies for technical help encouraging indigenous technical knowledge (ITK), following the procedure of proper planning and undertaking regular evaluation of the project. However, encouraging innovative ideas of local farmers is a must not only to progress in agriculture, but also to keep agriculture moving without losing natural resources.

INFERENCE

The study was conceived out of the necessity to find the solution to deteriorating ecology of the areas under coastal districts of Orissa. To preserve and maintain ecology not only the technology, but also the mind of the people perceiving sustainability is more important. The perception of the people and action of individuals are not independent of socio-economic environment in which they reside and work. The present investigation studied as much as twenty-four variables among personal, social, communication behaviour, marketing and training, those exclusively belong to individual domain. The study, while arriving at conclusion strongly recommended that before initiating measure for sustainability in agriculture, the socio-economic profile of the people concerned are to be taken into consideration, along with situations of villages and districts. The findings can also be replicable under similar situations of the other coastal districts. The parameters like education, farming, family composition, caste structure, membership in different organisations, size of land holding, occupational status, cropping system, animal wealth, flow of information, marketing and training have significant bearing on farmers and their expression which would serve as aid in formulating programmes relating to the sustainability of agriculture. The study strongly believes that programme designed for agriculture department should take into account the environmental factors and also common opinion of the people which stem from socio-personal characteristics, on the basis of perception of the villager.

(The study highlights the inter-relationship among the factors of sustainability like Ecological soundness, Economic viability, Social accessibility, Humaneness and Adaptability. These are the basic elements for planning programmes on sustainability.

The field functionaries at micro-level can gain insight about these factors and role in designing sustainable agriculture.

The perception of the farmers about sustainability of agriculture must be studied in order to stimulate them for action. In an agriculturally state like ours, the factors like Ecological soundness, Economic viability, Social accessibility, Humaneness and Adaptability are of great importance in maintaining productivity and profitable level. Again these factors consist of sub-factors at operational level. To attend these factors for designing of sustainability of agriculture, there is need to understand components of each factors which the study has brought out.

Our attempt for sustainable agriculture mainly depend on soil, water, air and forest which form components of sustainability of agriculture. The Ecological soundness, Economic viability, Social accessibility, Humaneness and Adaptability are to be taken care of to attain sustainability in agriculture. Again these components can play their role effectively provided effective extension approaches are adopted in a planned manner. The study has adequately cared these aspects and has brought out specific measures to attain sustainability in agriculture.)

BIBLIOGRAPHY

BIBLIOGRAPHY

- Agarwal, M.S. (1997). Planning for sustainable and regional development. Kurukshetra. Jan-Feb:104-106.
- Al Jalaud, A.A., Hussain, G., Yajima, M., Okada, K. and Matsumoto, N. (2002). Crop production and management in semiarid and arid environment. Proceedings of the 8th JIRCAs International Symposium, Tsukuda, Japan, 27-28 November, 2001. JIRCAs International symposium Series, 2002, No.10.105:116.
- Alagesan, N. (1999). Farmers' knowledge on bio-fertilizers and bio-control agents. Journal of Extension Education 10(3): 2534-2536.
- Ali, M.S.S. (1998). Developing sustainable agriculture programme putting the farmers knowledge. Journal of Social-Economic-Pertanian, Indonesia (1998), No. 4, 17-22.
- Altieri, M.A. (1992). Agroecological foundations of alternative agriculture in California. Agriculture, Ecosystems and Environment, 39 (1 – 2) : 23-53.
- Anderson, P. (2000). Insufficient investment. The Hindu Survey of Indian Agriculture, 21-23.
- Atkinson, W., Watson, C.A., Pearce, B., Wood Warl, L., Wolfam Welh, J. and Nowa, C.K. (2002). Organic agriculture and GM crops. The BCPC conference: Pest and diseases. Proceedings of an International conference, Brighton U.K. 18-21 November – 2002, British crop Protection Council; Farmham, U.K. 523-530.

- Barad, A.V., Poshia, V.K., Dhaliwal, G.S., Arora, R., Randhawa, N.S. and Dhawan, A.K. (1998). Planning technology for sustainable agriculture. Ecological, agriculture and sustainable development. Volume 2. Proceedings of International Conference on Ecological Agriculture Towards Sustainable Development, Chandigarh, India, 15-17, November: 419-429.
- Basawarajaiah, V. (2001). Impact of Edira watershed development programme on farm families in Mahaboobnagar district o Andhra Pradesh. M.Sc (Ag.) Thesis Unpublished, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad. 3.
- Bautista, E.U. (2003). Mechanising rice agriculture in the Philippines. Proceedings of the Philippines Rice RDRE Scholar's Forum. Maligaya, Nleeva Ecija (Philippines). Phili Rice and PA BAR 2000, 316.
- Bhavsar, V.M. (2002). Certified organic farming principle and practices, a course linking farmers and University students. Journal of Natural Resource and life Science Education, 2002, 31: 20-24.
- Bhople, R.S. and Lakhdive, B.A. (1998). Use of neem seed extract for control of crop pests by farmers. Agricultural Extension Review, 10(3): 29-30.
- Bhople, R.S., Shinde, P.S. and Dhule, S.S. (2001). Knowledge and adoption of bio-control pest management in cotton. Maharashtra Journal of Extension Education, 20: 18-21.
- BIFADEC (1991). Sustainable Agriculture is the solution, but what is the problem? Occasional paper no.14, Agency for International Development, Washington, 69.
- Borkar, M.M., Chothe, G.D. and Lanjewar, A.D. (2000). Characteristics of farmers influencing their knowledge about use of bio-fertilizers. Maharashtra Journal of Extension Education, 19: 130-131.

- Brundtland, (1987). "World Commission of Environment and Development", developing the broad political concept of sustainable development, published its report, *Our Common Future*, April 1987: 10.
- Bussche, P.F.V., Bussche, P.F.V. and Bussche, P.F.V. (2002). Sustainable development in Germany and Europe, the changing paradigm. *Entwicklung – Landlicher –Rau*, 36(4) : 17-19.
- Cai, Y. and Smith, B. (1994). Sustainability in agriculture: a general review. *Agric-ecosystem environ* Amsterdam; NewYork: Enseeier, 193-June, 1994, 49(2): 299-307.
- Chakraborty, T., Mallik, R.B., Dasgupta, M.K., Ghosh, D.C, Dasgupta, D., Majumdar, D.K., Chattopadhyay, G.N., Ganguli, P.K., Munsu, P.S. and Bhattacharya, D. (1995). Concept of sustainability in agriculture under Indian context – major issues and resource recycling. *Proceedings National symposium on sustainable agriculture in sub-humid zone*, March 3-5, 2 : 12-19.
- Conway, G.R. (1990). The challenge of sustainable agriculture. *Environmental Education and Sustainable Development*, 5: 185-186.
- Cothe, G.D. and Borkar, M.M. (2000). Constraints faced by farmers in adoption of bio-fertilizers. *Maharashtra Journal of Extension Education*, 19 (4): 298-299.
- Cox, J.W., Mc. Vicar, T.R., Reuter, D.J., Wang, H., Cape, J. and Fitzpatric, R.W. (2002). Assessing rainfed and irrigated farm performance using measures of Water Use Efficiency, Regional water and soil assessment for managing sustainable agriculture in China and Australia, 2002, 70-81.

- Dabrowski, Z.T. (2000). The necessity of changes in the methodology of development and implementation of integrated pest management. *Progress in Plant Protection*, 40(1) : 334-342.
- Dhillon, R.P. (2000). A study on farmers' awareness regarding agricultural pollution in Punjab. M.Sc. thesis, Punjab Agricultural University, Ludhiana, India.
- Dunlap, R.E., Beus, C.E., Howell, R.E. and Wand, T. (1992). What is sustainable agriculture? An empirical examination of faculty and farmer definitions. *Journal of Sustainable Agriculture* 3(1): 5-39.
- Eichhorn, H., Evcim, U., Dengirmencioglu, A., Demir, V., Yalcin, H. and Ozden, K. (2002). The role of agricultural Engineering in sustainable farming under regional and global challenges. *Proceedings of 8th International Congress on Mechanisation and Energy in Agriculture*, Kusadasi, Turkey-15-17 November, 2002, 1-4.
- Elangovan, R. and Vasanthakumar, J. (1997). Perception of extension officials towards eco-friendly technologies. *Journal of Extension Education* 8(2): 1755-1758.
- Fadini, M.M.M. and Lauzada, J.N.C. (2001). Environmental impacts of conventional agriculture. *Informe agripecuario*, 2001, 22(213): 24-29.
- Flora, C.B. (2001). Access and control of resources. Lessons from SANREM CRSP. *Agriculture and Human values*, 2001, North Central Regional Centre for Rural Development, Department of Sociology, IOWA state. 18(1) : 41-48.
- Gelderman, U. and Kogel, K.H. (2002). Natured Concept. The new agriculture amidst ecology and economy of the gene. *Journal of Agronomy and Crop Science*, 2002, 188(6): 368-378.

- Ghadei, K. (1996). Control of environmental pollution for sustainable agriculture as perceived by the farmers. M.Sc. (Ag.) Thesis, Orissa University of Agriculture and Technology, Bhubaneswar. 3.
- Gips, T. (1986). What is Sustainable Agriculture? In Allen Pand van Dusen D. (Eds.), Global perspectives on Agroecology and sustainable agricultural systems. Proceedings of the 6th International Scientific Conference of the International Federation of Organic Agriculture Movements (Santa Cruz: Agroecology Programs).
- Gowda, M.J.C. (1996). Sustainability of rice farming in different ecosystems. Ph.D. Thesis Unpubl., University of Agricultural Sciences, Bangalore. 1.
- Gowda, V., Govinda, L. M.T. and Chandrasekhar, S. V. (2000). Knowledge of farmers on dryland farming practices in groundnut cultivation. Journal of Extension Education 11(1): 2651-2655.
- Harrington, L.W. (1992). Measuring sustainability and alternatives. Journal of Farming Systems Research and Extension 3(1): 1-20.
- Hasbi, H. (2001). Management of agriculture for organic coffee by using organic matter to improve the sustainability. Sustainable development in the context of globalization and locality: Challenges and options for network in South East Asia. Proceedings of a workshop, Bogor, Indonesia, 18-22 September 2000. Trompenlandwrit, Beiheft, 2001, 73: 136-149.
- Haque, S.M.A., Haque, M.E. and Hossain, M.A. (1999). Farmer's knowledge on use of organic matter in crop production. Bangladesh Journal of Training and Development 12(1-2): 19-24.
- Hoff Gimenez, E. (2002). Measuring farmers agro-ecological resistance after Hurricane, Mitch in Nicaragua: a case study in participatory, sustainable land management impact monitoring, agriculture, ecosystem and environment, 2002. Department of environmental studies, 321 Nature sciences, 2, university of California, Santacruz, 1156 High Street, Santacruz, CA 95064, USA. 93(1-3): 87-105.

International Green Front Report (1998). Permaculture, pp:106-122.

Izac, A.M.N., Swift, M.J. and Dverak, K.A. (1992). Unpublished paper, CGIAR Social Science Meet, ISNAR, The Hague Aug. 1992. 2.

Jalali, B.L., Jalali, I., Dhaliwal, G.S., Arora, R., Randhawa, N.S. and Dhawan, A.K. (1998). Dynamics of integrated disease management in sustainable agriculture. Ecological agriculture and sustainable development: Volume 2. Proceedings of International Conference on Ecological Agriculture: Towards sustainable development, Chandigarh, India, 15-17 November: 355-365.

Jayasree, K. and Prasad, R.M. (1994). Analysis of dimensions of sustainable agriculture. Journal of Extension Education 5(1): 822-826.

Jirli, B.V. and Gangadharappa, N.R. (1997). Cognitive domain of vegetable growers with respect to integrated pest management. Mysore Journal of Agricultural Sciences, 31(1): 98-102.

Jirli, B.V. and Gangadharappa, N.R. (1997). Psychomotor domain of vegetable growers with respect to integrated pest management. Mysore Journal of Agriculture Sciences, 31(3): 271-275.

Jitsenguan, T. (2001). Sustainable agricultural systems for small scale farmers in Thailand. Implications for the environment. Food and fertilizer Technology center 2001, Food and fertilizer Technology center for Asian and pacific region, Taipei, Taiwan. 11 (11): 509.

Jonson, B. (2002). Crop protection in integrated production of field vegetables in Sweden - the status of IPM. The BCPC conference, Pests and diseases, Proceedings of an International conference Brighton 18-21 November 2002, 1 (1 & 2): 471-478.

- Kadam, J.R., Patil, V.G. and Hardikar, D.P. (2001). Knowledge and adoption of soil and water conservation practices in watershed development project. Maharashtra Journal of Extension Education, 20 (1): 138-140.
- Kalaskar, A.P., Shinde, P.S. and Bhople, R.S. (1999). Correlates of adoption of integrated pest management technology by cotton growers. Maharashtra Journal of Extension Education, 18 (2) : 45-48.
- Kalaskar, A.P., Shinde, P.S., Bhople, R.S. and Geete, M.H. (2001). Factors influencing knowledge of cotton growers about integrated pest management practices in cotton. Maharashtra Journal of Extension Education 20 (2) : 117-119.
- Kassa, H., Gibbon, D. and Singh, B.P. (2002). Livestock improved house hold food security and sustainability of Ethiopian small farms. Journal of Sustainable Agriculture, 2002, 21(2): 73-93.
- Katar, S. (1995). The watershed management approach to sustainability of renewable common pool natural resources: lessons of India's experience. Research paper, Institute of Rural Management, Anand, 14 (5) :17.
- Katyal, J.C. (1997). Relevance of integrated concept. The Hindu Survey of Indian Agriculture 1997, 25-31.
- Katyal, J.C. Das, S.K., Rao, U.M.B. and Reddy Y.V.R. (1992). Towards sustainable Agriculture, Intensive Agriculture, July-August, 1992, 3-11.
- Kerlinger, F.N. (1973). Foundation of behavioural research. Holt, Rhinehart and Winston Incorporation, New York, pp. 112.
- Kern, M.S. and Geiss, J. (1999). Endosulfan (Thiodan – R) – a cornerstone of IPM/ ICM. Proceedings of the 5th International Conference on Pests in Agriculture. Part – 3, Montpellier, France, 7-9 December, 835.

- Keufer, E. and Van Elson, T. (2002). Nature conservation advising for farmers. Survey amongst owners of organic farms in lower Saxony. *Natur schutz-Und-Landschafts-planung*, 2002, 34(10): 293-399.
- Khabeta, T.S. M. (2002). Farm size and soil loss: prospects for a sustainable agriculture in kwazulu – Watal. *Agrckan*, 41(2): 135-146.
- Khan, M.S. (1999). Critical analysis of eco-friendly technologies in rice cultivation – A study in an adopted village – Kondubhotlapalem. M.Sc.(Ag.) Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad. 9.
- Koocheki, A., Dhaliwal, G.S., Arora, R., Randhawa, N.S. and Dhawan, A.K. (1998). A quantifying approach for evaluating sustainable agriculture in Iran. *Ecological agriculture and sustainable development: Volume 2. Proceedings of International conference on Ecological Agriculture: Towards sustainable development, Chandigarh, India, 15-17 November, 1997*, 10 : 1-5.
- Kumar, A.A., Babu, B. and Ramachandran, U. (1999). Attitude of farmers towards agro-forestry programme in Kerala. *Indian Ajournal of Forestry* 22(1 & 2): 155-159.
- Kutty, J.K. (1996). Analysis of the management for sustainable agriculture by the farmers of Kerala. Ph.D. Thesis Unpubl. Kerala Agricultural University, Thrissur. 13.
- Lahiry, S.C. (1997). Sustainable economic development. *Kuruksheetra*, Jan-Feb: p. 39-40.
- Lakhan, S., Sinha, B.P. and Singh, L. (1999). Constraints in watershed development in Doon Valley. *Indian Journal of Soil Conservation*, 27(1): 74-77.

- Landell, M.N. (2002). Marketing forest environmental services who benefits. Gatekeeper series. Sustainable agriculture and Rural Livelihoods. Programme International Institute for Environment and Development, 2002. International Institute for Environment and Development (IIED): London, U.K. No.104 : 22.
- Lawrence, A. (1994). The meaning of sustainability for extensionists: Indicators for assessing technological innovations. International workshop on alternative and cost-effective extension approaches for sustainable agriculture: Methodological Issues, TNAU, Coimbatore. 4.
- Lefroy, E.C. and Hobbs, R.J. (1992). Ecological indicators for sustainable agriculture. Australian Journal of Soil and Water Conservation 5(4): 22-28.
- Lehar, F. Von (1999). Development of man effective conservation farming system through participatory on farm research. American Journal of Alternative Agriculture. 1999, 14(C) : 98-102.
- Liu, G., Xu, M., Rui, L., Walker, J., Mu, W., Liu, G.B., Xu, Mx., Rui, L., Hu, Wy., and Mc Vicar, T.R. (2002). Assessment of a small catchment on the Loess plateau. Regional water and soil assessment for managing sustainable agriculture in China and Australia. (Eds) Mc Vicar, T.R., Rui, L., Walker, J., Fitzpatrick, R.W. and Changming, L., NWSUAF, Yangling, Shaanxi., 712100, China, pp. 139-144.
- Lohani, S.N., Chhetri, K.K. (2001). Women in sustainable agriculture development and environment. Agriculture and Environment Communication issue. Kathmandu (Nepal), Ministry of Agriculture and Cooperatives, 2001, 7-14.
- Loker, W.M. (1994). Where is the beef? Incorporating cattle into sustainable agroforestry systems in the Amazon Basin. Agroforestry Systems, 25(3) : 227-241.

- Manjunath, L., Balamati, A.M. and Biradar, N.D. (1998). A study on differential perception of attributes of selected innovations by farmers. Rural India, pp: 40-43.
- Manjunatha, B.N., Lakshminarayan, M.T., Anand, T.N. and Kumar G.T.P. (1999). Factors affecting adoption of sustainable sugarcane farming practices – A Discriminant function analysis. Mysore Journal of Agricultural Sciences 33: 375-378.
- Mbata, J.N. (2001). Land use practices in Lesotho: implication for sustainability in agricultural production. J-Sustain-agric. Binghamton, N.Y. Food Product Press, C-1990-2001, 18(2&3): 5-24.
- Mc Donald, A., Vasconalás, M.C. and Lozzia, C. (2001). Low input viticulture and entomology cregon proceedings of 20BC – WPRs working group "Integrated Control in Vitivulture" at ponte de lima, Portugal, 2-7 March 2001, Bulletin OLLB – SROP, 2001, 24(7), 173-181.
- Mendoza, T.C. (1994). Incorporating sustainability in national food production and agricultural extension programmes in the Philippines. Farm Management notes, 17(6): 32-43.
- Muthuraman, P. (1995). Adoption pattern of organic manures in rice based cropping systems. Journal of Extension Education 6(3): 1229-1232.
- Nadakarni, M.V. (1993). Sustainable Development: Concept and issues with special reference to agriculture. Indian Journal of Agricultural Economics 48(3): 516-525.
- Nagabhushanam, K. (1997). Sustainability of agriculture in watershed environment – An analysis. Ph.D. Thesis Unpubl. TNAU, Coimbatore.

- Nagdeve, D.P. (1999). Plant protection status of IPM-trained dry paddy farmers in Vidarbha region of Maharashtra state. Ph.D. Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Hyderabad.
- Nirmala, L. and Ravichandran, V. (1995). Factors influencing knowledge and adoption of bio-fertilizers. *Journal of Extension Education* 6(2): 1183-1184.
- Nirmala, L., Ravichandran, V. and Radhakrishnan, T. (1995). Information sources utilization influencing knowledge and adoption of bio-fertilizers. *Journal of Extension Education* 6(1): 1061-1064.
- Norman, S. and Warmark. C. (2003). Farm sustainability in the semi arid tropics – a case study of small farms in Nicaragua using sustainability indicators. Minor-Field-Studies-Inter-national-Office, Swedish-University of Agricultural-Sciences, 2000, 222 : 93.
- Ohlander, L, Lagerburg, C. and Gertson, U. (1999). Vision for ecologically sound agriculture systems. *Journal of sustainable agriculture* (1999), 14 : 73-79.
- Padhee, A.K. (1995). Sustainable pest management. *Yojana*, 39(8): 13-14.
- Padmavathi, M. (1996). Role perception and role performance of Mitra Kisans in National Watershed Development Project in Rainfed Areas (NWDPA) in Chittoor district of Andhra Pradesh. M.Sc.(Ag.) Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Hyderabad. 2.
- Panigrahi, R. and Sarangi, B. (1996). Role of alternative farming systems in the quest for sustainable agriculture. *Journal of Extension Education (Orissa)*, 1 (1 & 2): 117-119.
- Paoletti, M.G., Stinner, B.D. and Lorenzone, G.G. (1989). *Agricultural Ecology and Environment*, Elsevier Science Publishers, Amsterdam, The Netherlands. p.1.

- Paroda, R. S. and Anderson, P. (2000). Insufficient investment. The Hindi Survey of Indian Agriculture, 2000, 21-23.
- Pimental, D., Thomas, W., Chillingly, I. M.O.W., Buttler, D., Reinmann, J. and Kenneth, B. (1989). Practices in Agricultural Ecology and Environment Ed. Poloetti M. Stinner, B.R. and Loren-zoin G.G. Elsever Science publishers B.V., Amsterdam, 3-24.
- Pornthip, K. (1998). People's participation in sustainable forest resource management. A case study of community forestry project. Bon Nam Ra Am phoekalono Saton Province, Bangkok (Thailand) 1998, pp. 150.
- Prasad, M.S. and Sundaraswamy, B. (2000). Attitude of farmers towards dryland agricultural technologies. Journal of Extension Education 11(1): 2666-2671.
- Ramamurthy, V.S. (2000). A study on Janmabhoomi programme in Chittoor district of Andhra Pradesh. M.Sc.(Ag.) Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Hederabad.
- Rambabu, P. (1997). Indigenous technologies in cropping systems – An analytical study in Guntur district of Andhra Pradesh. Ph.D. Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Hyderabad.
- Rahman, M.Z., Mikani, H. and Rahman, M.M. (1999). Towards sustainable farming development: The attitude of farmers in a selected area of Shimane prefecture, Japan. Journal of Sustainable Agriculture 14(4): 19-33.
- Rahman, M.Z. and Mikani, H. (1999). Farmer's attitudes towards sustainable agricultural issues and environmental quality in a selected area of Bangladesh. American Journal of Alternative Agriculture 14(1): 22-29.

- Rai, J.P.N., Vikas, S., Pratibha, S.V., Arunachalam, A. and Khan, M.L. (2001). Environmental management through sustainable agriculture. In: Sustainable management of forests, Ed. Arunachalam, A. International Book Distributors, Dehra Dun, India, pp. 493-502.
- Rai, M. (2005). Internalising synergies. The Hindu Survey of Indian Agriculture, p. 20-27.
- Raj, R.K. and Satapathy, C. (2003). A study on extension and management issues in implementation of watershed development project. Ph.D. thesis submitted to Orissa University of Agriculture & Technology, Bhubaneswar, p. 146.
- Raju, K. A. and Radhakrishna, M.C. (2000). Constraints faced by farmers in betelvine cultivation. Maharashtra Journal of Extension Education 19: 308-311.
- Rauta, (1997). Sustainable agriculture in Pemanian. Revista-Societalei-National Romane-Pentru Steinta-Solului-Seria, IIIa. 1997. 31 : 3-10.
- Reddy, M.R. (1996). Plant protection training needs of vegetable growing farmers in Ranga Reddy district of Andhra Pradesh. M.Sc.(Ag.) Thesis Unpubl. Acharya N.G. Ranga Agricultural University, Hyderabad.
- Reetz, H.F. (1990). Sustainable innovations – A part of not apart from conventional agriculture. Better Crops, Spring : 6-10.
- Reijntjes, C., Bertus, H. and Waters, B.A. (1992). Farming for the future, ILEM, Netherlands, p.2.
- Resmy, C, Shivamurthy, and Mahadevaiah, G.S. (2000). Knowledge level of small and big farmers in sustainable practices of coconut and banana intercropping. Land Bank Journal 39(4): 39-43.

- Sabarathnam, V.E. (2002). R/R/PRA for Agriculture. Rapid, Relaxed and Participatory Rural Appraisal (Participatory Learning and Action). For Research and Extension in Agriculture (For crops and livestock) Vamsamarath publications Hyderabad, 2002, 398-417.
- Sadangi, B. (1997). Farmers response towards sustainable agriculture. Seminar report on sustainable agriculture organized by CART (Dec. 28-29th) at Orissa University of Agriculture & Technology, Bhubaneswar.
- Saha, A.C. (2001). In the hands of people: an Indian case of watershed development, 2001, International Institute for environment and development (IIED), London, U.K., 78.
- Sathapathy, C. and Das, R.N. (1997). Farmers of Orissa in contrast of sustainable agriculture. Seminar report on sustainable agriculture organized by CART (Dec. 28-29th) at Orissa University of Agriculture & Technology, Bhubaneswar.
- Saxena, K.K. and Singh, R.L. (2000). Adoption of organic farming practices by farmers of Malwa region. Maharashtra Journal of Extension Education 19 : 53-55.
- Sharma, A.K. (2003). Organic Product, making competitive with 3N's nature + native + neighbour, Agro bios Newsletter, 1 (13) : 2000.
- Sharma, A.K. (2003). Search of sustainability. Agro Bios Newsletter, 1 (13) : 2003.
- Shinde, P.S., Bhople, R.S. and Vaidya, V.R. (1997). Adoption of integrated pest management practices by cotton growers. Maharashtra Journal of Extension Education 16: 167-174.
- Shrivastava, L.S. (1998). Agriculture in India by 2000 A.D. – Emerging opportunities. National Book News Review, Bombay, 14(4): 38-43.

- Siddiq, E.A. (2000). Yawning productivity gaps. The Hindu Survey of Indian Agriculture, 39-44.
- Singh, K.A. (1997). Attitude of farmers towards social forestry programme: an analysis. Journal of Research ANGRAU, 25(2): 27-30.
- Singh, R.P., Paroda, A.S., Joshi, N.L., Kathju, S. and Amalkar, K. (1999). Sustainable crop production strategies for management of arid and semi-arid ecosystems. Recent advances in management of arid ecosystem. Proceedings of a symposium held in India, March 1997: 91-120.
- Singh, R.B. and Kelayutham, M. (2001). Balancing crop and animal productivity and environment. Proceedings of Asian Agricultural Congress, Manila, Philippines 24-27 August 2000, 314.
- Singh, R. (2004). Role of chemical pollutants in Agro-Ecosystems and Environment – Some considerations. Agro bios Newsletter, 2 (8) : 54-56.
- Singh, M.P. and Singh, D.B. (2004). Biodiversity why? A land of Hue and cry at present. Agro bios Newsletter, 2 (8) : 14-16.
- Srinivasa, G., Dolli, S.S., Raveendra, M. and Iyengar, M.N.S. (1996). Socio-economic factors and their relation to adoption of improved sericultural practices. Indian Journal of Sericulture 35(1): 43-45.
- Sriram, N. and Palaniswamy, A. (1999). Farmers extent of adoption of eco-friendly agricultural practices in cotton cultivation. Journal of Extension Education 10 (1) : 2318-2323.
- Stockle, C.O., Panpendick, R.L., Saxton, K.E., Campbell, G.S. and Van-Evert, F.R. (1992). A frame work for evaluating sustainable agricultural production systems, Am. J. Altern. Agric., Greenbelt, Wallace Institute of Alternative agriculture, 9(1-2): 45-50.

- Sudhakar, G., Lourduraj, A.C., Rangaswamy, A., Subbin, P. and Velayutham, A. (2002). Effect of vermicompost application on the soil properties, nutrient availability, uptake and yield of rice – a review. *Agricultural Reviews*, 2002, 23(2): 127-123.
- Sumathi, P. and Alagesan, V. (1998). A correlation analysis between the characteristics of respondents with their awareness and adoption behaviour of IPM in groundnut. *Journal of Extension Education* 9 (3) : 2143-2144.
- Swaminathan, M.S. (1991). Dimensions of sustainable agriculture. In : *Extension Digest*, MANAGE, Rajendranagar, Hyderabad 4(2): 3-4.
- Swaminathan, M.S. (2000). For on Evergreen Revolution. *The Hindu Survey of Indian Agriculture*, 2000, 9-15.
- Swaminathan, M.S. (2005). Three – pronged strategy needed. *The Hindu Survey of Indian Agriculture*, 2005, 8-15.
- TAC/ CGIAR (1989). *Sustainable Agricultural Production: implications for international agricultural research*, Rome, FAO, p.xi.
- Teng, P.S. (1999). Sustainable agriculture: Industry's challenges. *Agro. Chemicals News*, 22(4) : 5-19.
- Tubene, S. and Harson, J. (2002). The whole sale produce auction. An alternative marketing strategy for small farms. *Am-J-atern-agric. Greenbelt*, M.D: Henry A. Wallace Institute for Alternative Agriculture. 17 (3 & 4) : 18-23.
- Venkataramani, G. (1991). Sustainable agriculture: Intensive research will pay off. *The Hindu Survey of Indian Agriculture*: 17-19.
- Verma, M.C. and Agarwal, M.S. (1997). Planning for sustainable and regional development. *Kurukshetra*, Jan-Feb.: 104-106.

Vijaya, A.K. (1996). Sustainability through natural farming. Intensive Agriculture. Nov-Dec.: 9-10.

Wuest, S.B., Mc. Cool, D.K., Miller, B.C. and Vesth, R.J. (1999). Globalisation of Pesticide Technology and meeting the needs of low impact sustainable agriculture. American Journal of Alternative Agriculture, 1997, 14(2) : 50-58.

Yadav, R.S., Jha, P.K. and Pandey, S.S. (1996). Sustainable agriculture for pollution free production. Indian Farmers Times, 27 (7): 11-13.

Yadav, P. and Mani, D. (2000). Mitigating pollution through integrated nutrient management system. Bioved 2000, 11(1-2): 75-77.

Yadav, B.K. (2004). Environmental Implications of organic Farming, Agro bios Newsletter, 2 (8) : 18-19.

APPENDICES

Title of the study : **Factors affecting Sustainability of Agriculture in small farm production system in coastal ecosystem of Orissa.**

INTERVIEW SCHEDULE
(Exclusively for farmers)

We are making a study to know the sustainability of agriculture of your area. You are requested to offer your free, frank and unbiased response.

Sl. No.

Date

1. Name of the respondent :
2. Address - Village
Block
Dist.
Pin code

PART - I
SOCIO PERSONAL INFORMATIONS

1. Age at present (completed years) :
2. Educational attainment
 - a) Illiterate
 - b) Primary
 - c) M.E. School
 - d) High School
 - e) College and above
3. Caste
 - a) SC
 - b) ST
 - c) OBC
 - d) Others
4. Type of family you reside in
 - a) Nucleus
 - b) Joint family
5. What is the composition of your family ?

Male	_____
Female	_____
Childrren	_____
Total	_____
6. Membership in formal organisation
 - a) Cooperatives
 - b) Farmer's club
 - c) Radio forum
 - d) Pani Panchayat
 - e) SHG
 - f) Farmers Interest Group
 - g) Vana Surakhya Samiti (VSS)
 - h) Any other

7. Exposure to mass media

A) How frequently do you read newspaper ?

- a) Everyday
- b) Occasionally
- c) Sometimes
- d) Never

B) Do you possess radio ? Yes / No

If Yes what programs really you listen ?

- a) News
- b) Entertainment
- c) Weather information
- d) Agricultural programs
- e) Any other

(Please check up programs from daily newspaper and enlist)

C) Do you possess TV ? Yes / No

If Yes, what programs do you view in TV. ?

- a) News
- b) Political views
- c) Entertainment
- d) Programme on agricultural and allied field
- e) Sports
- f) Any other

8. What is your major and minor occupation ?

<u>Occupation</u>	<u>Major (>60%)</u>	<u>Minor (<60%)</u>
a) Farming		
b) Business		
c) Wage earning		
d) Service		
e) Any other		

(Major occupation means the sources from which more than 60% of the income comes from)

9. Since how many years you are in farming ? _____ .

10. What is your land position ? :

- a) Total land owned _____
- b) Total land under cultivation _____
- c) Total land leased out _____
- d) Total land leased in _____

11. What are the crops do you normally grow with area ?

<u>Crop</u>	<u>Kharif (ha)</u>	<u>Rabi (ha)</u>
a) Paddy		
b) Pulse		
c) Oilseed		
d) Vegetable crops		
e) Cash crops		
f) Any other		

12. How much of your area is under irrigation ?

Area under irrigation : Kharif _____ ha

Rabi _____ ha

13. What are the sources of irrigation ?
- Canals
 - LI Points
 - Tank (pond)
 - Well
 - Tube well
 - Pond
 - Any other
14. What farm machinaries do you possess ?
- | <u>Name of the machinery</u> | <u>Nos</u> |
|------------------------------|------------|
| 1. Tractor | |
| 2. Power tiller | |
| 3. Sprayer | |
| 4. Sprinkler | |
| 5. Any other specify | |
15. Animal wealth
- | <u>Name of the animal</u> | <u>Nos</u> |
|---------------------------|------------|
| 1. Cow | |
| 2. Bullock | |
| 3. Buffaloes | |
| 4. Small ruminants | |
| Goat | |
| Sheep | |
| 5. Poultry / Duck | |
| 6. Rabbit | |
| 7. Any other | |
16. Where do you sell your farm produce ?
- Own village
 - Nearby market
 - Block HQ
 - Dist. Headquarter
 - Outside district
 - Outside state
 - Do not sell at all
17. What is your opinion regarding selling price of your farm produce ?
- Quite remunerative
 - Remunerative at times
 - Not remunerative
 - Less concern
18. If farm produce is not remunerative, what may be the reason ?
- High Cost of production
 - Less Market demand
 - Middlemen take more profit
 - Products lack Value addition
 - No scope for storage
 - Any other please mention
19. What is your view about farm produce ?
- Just manageable
 - Little over family maintenance

- c) Much more than family requirement
- d) Only grow for marketing
- e) Any other reason

20. Do you have livestock and fishery to add to your family income ? Yes / No
If Yes, what are they

Items	Number
Milch cow	
Buffalo	
Bullock	
Poultry	
Duck	
Fishery (Pond of what size)	

21. Do you use energy in agriculture ? Yes / No

If Yes, how much energy bill do you pay / month or season or year ?

22. How many of your family members are involved in farming ?

- a) Directly _____
- b) Indirectly _____

23. Do you look after your farming ? Yes / No

If Yes, What are your responsibilities ?

- a) Only supervisory work
- b) Supervision & Management
- c) Direct work in the field
- d) Supervision, management & field work
- e) Any other

24. Have you ever gone on any training on agriculture & allied ? Yes / No

If Yes, Where

Institution	Period
a) KVK	
b) Agril. Dept.	
c) NGO	
d) Any ot	

25. Have you ever used knowledge that you gained after coming from training? Yes/ No

If Yes, what new ideas you have adopted after being trained ?

- 1.
- 2.
- 3.

If No, What are the reasons ?

1. Not fully convinced with training
2. Lack of resource to put knowledge gained in training into action
3. Training not related to your problem
4. Any other reason (specify)

PART – II
(A) FACTORS OF SUSTAINABILITY OF AGRICULTURE

Sustainability in Agriculture is discussed at various levels. There may be many factors of sustainability. We have listed some. Please add if you feel other factors are there and rate them assigning ranks. *

Sl. No	Factors	Rank
1	Ecological soundness	
2	Economic viability	
3	Social Accessibility	
4	Humaneness	
5	Adaptability	

(Rank as I, II, III, IV and V in order)

(B) PERCEPTION ABOUT SUSTAINABILITY OF AGRICULTURE

Ecology is one of the important factors of Sustainability. Ecological Soundness as such consists of many ingredients Please record your response against each statement in a five point scale as you feel appropriate.

SA – Strongly agree, A- Agree, UD- Undecided, DA- Disagree, SDA- Strongly Disagree
Ecological Soundness

Sl. No.	Statement	SA	A	UD	DA	SDA
1.	The soil condition of an area with regards to , its structure & fertility, level of organic matter reveal the soundness of the ecology.					
2	Availability of groundwater and its nearness to root zone of crops indicate good ecological status.					
3	The maintenance of nutrients of soil in form of NPK and other minor elements helps to have sound ecology of an area.					
4	Types of farming including crop rotation, land use pattern etc are the main indicators of ecological soundness leading to sustainability.					
5	Use of organic fertilizers such as FYM, Compost and Green Manuring leads to good ecology and sustainability in agriculture.					
6	Use of Bio-pesticides and fungicides add to maintenance of ecological soundness.					

Economic Viability

Sl. No.	Statement	SA	A	UD	DA	SDA
1.	Level of production and its stability are important factors of economic feasibility that leads to sustainability.					
2	Conservation of natural sources is an important factor to have economically feasible agriculture.					
3	Increase in profitability in the existing farming system leads to economic feasibility.					
4	Sustainable in agriculture provides enough income to meet the requirement of family.					
5	Livelihood management consisting of animal and crop component on a profitable manner indicates the economic feasibility leading to sustainability.					
6	Cost of production should be less for more profit					

Social Accessibility

Sl. No.	Statement	SA	A	UD	DA	SDA
1.	Sustainability in agriculture ensures accessibility of all families to consume village resources.					
2	Availability and use of energy in Agriculture is an Important component of social accessibility leading to sustainability in agriculture.					
3	To maintain sustainability adequate technical / technological support is necessary					
4	Availability of capital at local level indicates social accessibility for sustainable agriculture.					
5	Sustainability of agriculture opens wide scope in marketing of farm produce					
6	Participatory decision making for use of common resources in village is another important out come of sustainability.					

Humaneness

Sl. No.	Statement	SA	A	UD	DA	SDA
1.	Humanness comes where respect for honesty and value system operates.					
2	It develops cordial relationship among different communities					
3	Sustainability implies respect for honourable living					
4	Sustainability can create climate of trustworthiness					
5	Sustainability of agriculture creates opportunity for compassion.					
6	Social solidarity is outcome of the sustainability in agriculture					

Adaptability

Sl. No.	Statement	SA	A	UD	DA	SDA
1.	Sustainability is achieved where villages tend towards progressiveness.					
2	Sustainability emphasizes accommodation of Govt. policies and technological change					
3	Sustainability makes market demand widened.					
4	Consumer preference is important to have sustainability in agriculture.					
5	Possible conflicts arise in adoption of sustainability methods/ practices and measures					
6	Sustainability provide scope for disaster management					

PART – III
SUB FACTORS OF SUSTAINABILITY OF AGRICULTURE

(A) We have secured your honest response on five important parameters of Sustainability of agriculture. Under factors there are sub factors. Please rank them as you feel appropriate.

VI -Very Important, **I** - Important, **LI** - Less Important

Ecological Soundness

Sl. No.	Item	VI	I	LI
1	Soil			
2	Water			
3	Nutrient			
4	Types of farming			
5	Use of Bio-pesticides and fungicides			
6	Use of organic manures			

Economic Viability

Item	VI	I	LI
1. Production			
2. Profitability			
3. Resource conservation			
4. Adequate income			
5. Profitable animal husbandry			
6. Profitable crop husbandry			

Social Accessibility

Item	VI	I	LI
1. Accessibility to village resources			
2. Availability of energy for agriculture			
3. Technological support			
4. Availability of Capital			
5. Market opportunity			
6. Participatory decision making			

Humaneness

Item	VI	I	LI
1. Respect for honourable living			
2. Cordial relationship			
3. Honourable living			
4. Climate of trustworthiness			
5. Feeling for others			
6. Social solidarity			

Adaptability			
Item	VI	I	LI
1. Accommodation for social change			
2. Accommodation for Govt. Policy and technological change			
3. Creation of market demand			
4. Preference of consumers			
5. Possible conflict in adoption of sustainability measures			
6. Scope for disaster management			

(Please see that under each factor, the sub- factors are ranked as per their relative position as far as you judge them correct.)

Sustainability of Agriculture is measured in different terms. We desire to know your valuable knowledge level and experiences about existing / operational variables involved in Sustainability.

(B) ADOPTION OF RECOMMENDED MEASURES OF SUSTAINABLE AGRICULTURE

Ecological soundness:

Q 1. In case you mark degradation of soil, what measures do you know that can preserve soil status?

a. Addition of more organic matter	
b. Crop rotation	
c. Balance use of chemical fertilizer	
d. Any other please specify	

Q2. To preserve the ground water for agriculture what practices do you follow ?

a. Check run off of water	
b. Grow vegetation	
c. Create irrigation facilities	
d. Develop watershed projects	
e. Any other (mention)	

Q3. Do you follow crop rotation to maintain sustainability of agriculture ? Yes---- / No---
If 'Yes', please state the rotation that you follow

- Paddy – paddy
- Paddy – vegetables
- Paddy – groundnut
- Paddy – pulses
- Any other (specify)

Q4. Do you know about bio-pesticides, bio-fungicides, bio-herbicides or bio-control agents and bio-fertilisers in agriculture ? Yes----- / No-----

If 'Yes', Please give their names :

Product	Name	Using	Not using
a. biopesticides			
b. biofungicides			
c. bioherbicides			
d. biocontrol agents			
e. biofertilisers			

Q5. There are many natural resources in your area like Soil, Water, Forest, Mountain, Animal etc. Do you know the conservation methods of these resources ? Yes / No
If Yes, What are they ?

Practices	followed	not followed
a.		
b.		
c.		
d.		
e.		

Economic viability:

Q1. Do you know the methods of increasing the productivity of your land?
Yes----No-----

If 'Yes', What are they ?

a. Use of HYV. Seeds	
b. Balance use of fertilizers	
c. Irrigation management	
d. Adoption of Post Harvest Technology	
e. Use of farm machinery	
f. Any other	

Q2. Do you follow the different means of increasing profitability of your farm ?Yes-- / No---

If 'Yes', What are they ?

a. Adoption of new technologies	
b. Use of information	
c. Contact with market	
d.. Method of value addition	
e. Any other (Specify)	

Q3. Please state the methods/means you know to make animal and crop husbandry profitable?

Methods

Crop	Animal
a.	
b.	
c.	
d.	
e.	

Social Accessibility:

Q1. Please give your reaction for the following statements .

Sl.No.	Statements	VI	I	LI
1.	All the families of your village have equal access to the common resources			
2.	Energy like Electricity/ diesel/ animal are available to all in the village			
3	Villagers Receive adequate technological support			
4	Capitals are available farming			
5	Prevalence of participatory decision making in common interest arises			

Humaneness :

Q1. Humaneness is important for living as well as sustainable farming system. Please record your reaction against each statement given below.

Sl. No.	Statements	Very much	Much	Little
1.	There is respect for honesty in society			
2.	Good relationship exists amongst the communities			
3	People respect much for honorable living			
4	There is a climate of trustworthiness			
5	Feelings for others is common in the village			
6.	Social solidarity being maintained in the village			

Adaptability:

Q. Please respond to the following questions as you feel appropriate.

Sl. No.	Statements	VI	I	LI
1.	The villagers welcome change in agriculture			
2.	People want to accommodate Govt. Policy and technological change in farming			
3	Market demand as farm produce is in increasing trend			
4	Consumer preference is receiving importance while planning for the produce			
5	There is conflict in adoption of methods to have sustainability			
6.	At present people know the technique of disaster management			

PART- IV**EXTENSION AND COMMUNICATION ELEMENTS**

I. For maintaining sustainability in agriculture we need cooperation of people in the locality. To have cooperation what kind of structure do you suggest at village level?

	Social structure	Response
1	Committee / organization for sustainability	
2	To utilize SHG for the purpose	
3	To reactivate Mahila Samiti and Youth Club for the purpose	
4	To take help of Govt. Policy	
5	Any other	

II. To ensure cooperation what kind of mechanism do you suggest to sustain on durable basis.

	Item	Response
1	Sustainable committee to sit frequently	
2	Inviting experts to committee	
3	Organising training on sustainability	
4	Field trip to areas of sustainable agriculture	
5	Any other suggestion	

III. Sustainability is a time taking process. Every individual in the committee has to participate in the process. Please indicate how to evaluate progress in the maintenance of sustainability.

	Item	Response
1	Periodical visit by experts	
2	Analysis of situation by sustainable committee	
3	Evaluating level of production and productivity	
4	Measuring level of living (socio-economic status)	
5	Study of reaction of people	

IV. For sustainability of Agriculture marketing of farm produce is very much important component. To provide remunerative price to producer what kind of marketing network you suggest.

	Item	Response
1	Fixation of price of produce by committee ~~Fixation of price of produce by ...~~	
2	Opening of Rayat bazaar/ Krushak bazaar	
3	Any other	

PART - V SUGGESTIONS

It is now well recognized that the farming is to be made sustainable for better living. There are many suggestions. But we need your honest suggestions.

1. Ecological soundness

What are your suggestions to maintain ecological soundness of the area ?
(Ecological soundness means soil, water, forest, mountain, animal and other natural resources)

a. Soil

b. water

c. Forest

d. Mountain

e. Animal

2. Economical viability

The present day agriculture does not seem to be economically viable. Please suggest measures to be adopted to increase economic viability without disturbing ecological soundness.

1. Productivity in crop

2. Productivity in animal husbandry

3. Overall profitability of farm

3. Social accessibility :

It is observed that all the families in a locality / village do not have equal accessibility to common resources. Please suggest how this can be ensured? .

1. Use of energy in agriculture
2. Technological support
3. Availability of input
4. Common decision to share the resources

4. Humaneness :

The present day society suffers greatly in the term of value system. Please suggest means and ways to maintain humaneness among the village people.

1. To maintain honesty
2. Good relationship among the people
3. Creating climate of trustworthiness
4. To maintain social solidarity

5. Adaptability :

Adaptability of technology leads to progressiveness. But many people do not adopt them. Please suggest how to ensure the adaptability of new technologies?

1. To accommodate technologies in farming system
2. To participate in marketing of farm produce
3. Ensuring consumer preference for better market
4. Preparedness to face disaster if any (Disaster means flood, cyclone drought etc)

APPENDIX II

Title of the study : **Factors affecting Sustainability of Agriculture in small farm production system in coastal ecosystem of Orissa.**

INTERVIEW SCHEDULE (For Experts only)

We are making a study to know the sustainability of agriculture of your area. You are requested to offer your free, frank and unbiased response.

Name:

Date

PART – I

(A) FACTORS OF SUSTAINABILITY OF AGRICULTURE

Sustainability in Agriculture is discussed at various levels. There may be many factors of sustainability. We have listed some. Please add if you feel other factors are there and rate them assigning ranks.

Sl. No	Factors	Rank
1	Ecological soundness	
2	Economic viability	
3	Social Accessibility	
4	Humaneness	
5	Adaptability	

(Rank as I, II, III, IV and V in order)

(B) SUB FACTORS OF SUSTAINABILITY OF AGRICULTURE

We have secured your honest response on five important parameters of Sustainability of agriculture. Under factors there are sub factors. Please rank them as you feel appropriate.

VI -Very Important, I - Important, LI - Less Important

Ecological Soundness

Sl. No.	Item	VI	I	LI
1	Soil			
2	Water			
3	Nutrient			
4	Types of farming			
5	Use of Bio-pesticides and fungicides			

Economic Viability

Item	VI	I	LI
7. Production			
8. Profitability			
9. Resource conservation			
10. Adequate income			
11. Profitable animal husbandry			
12. Profitable crop husbandry			

Social Accessibility

Item	VI	I	LI
1. Accessibility to village resources			
2. Availability of energy for agriculture			
3. Technological support			
4. Availability of Capital			
5. Market opportunity			
6. Participatory decision making			

Humaneness

Item	VI	I	LI
1. Respect for honourable living			
2. Cordial relationship			
3. Honourable living			
4. Climate of trustworthiness			
5. Feeling for others			
6. Social solidarity			

Adaptability

Item	VI	I	LI
2. Accommodation for social change			
2. Accommodation for Govt. Policy and technological change			
3. Creation of market demand			
4. Preference of consumers			
5. Possible conflict in adoption of sustainability measures			
6. Scope for disaster management			

(Please see that under each factor, the sub- factors are ranked as per their relative position as far as you judge them correct.)

PART – II

SUGGESTIONS

It is now well recognized that the farming is to be made sustainable for better living. There are many suggestions. But we need your honest suggestions.

1. Ecological soundness

What are your suggestions to maintain ecological soundness of the area ?

(Ecological soundness means soil, water, forest, mountain, animal and other natural resources)

a. Soil

b. water

c. Forest

d. Mountain

e. Animal

2. Economical viability

The present day agriculture does not seem to be economically viable. Please suggest measures to be adopted to increase economic viability without disturbing ecological soundness.

1. Productivity in crop

2. Productivity in animal husbandry

3. Overall profitability of farm

3. Social accessibility :

It is observed that all the families in a locality / village do not have equal accessibility to common resources. Please suggest how this can be ensured? .

4. Use of energy in agriculture
5. Technological support
6. Availability of input
7. Common decision to share the resources

4. Humaneness :

The present day society suffers greatly in the term of value system. Please suggest means and ways to maintain humaneness among the village people.

8. To maintain honesty
9. Good relationship among the people
10. Creating climate of trustworthiness
11. To maintain social solidarity

5. Adaptability :

Adaptability of technology leads to progressiveness. But many people do not adopt them. Please suggest how to ensure the adaptability of new technologies?

12. To accommodate technologies in farming system
13. To participate in marketing of farm produce
14. Ensuring consumer preference for better market
15. Preparedness to face disaster if any (Disaster means flood, cyclone drought etc)